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Large Truck Crash Causation Study

Interim Report

Prepared By:

NCSA

National Center for Statistics and Analysis
Advanced Research and Analysis

For:

FMCSA
Federal Motor Carrier Safety Administration

Office of Data Analysis and Information Systems
Federal Motor Carrier Safety Administration

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Abstract

This interim report has been prepared to introduce and describe the Large Truck Crash Causation Study (LTCCS). This report discusses the background, study design, field methodology, and early data tallies for the study of large truck crashes. Description of existing data collection infrastructure is discussed to provide an understanding as to why and how this special project was conceived and designed. Preliminary tallies of the LTCCS data are presented to give an overview of the types of crashes being investigated, as well as to give an idea of future potential analyses. However, no national estimates of proportions, relationships, or risks should be inferred from them.

The Large Truck Crash Causation Study (LTCCS) is a three-year data collection project conducted by the National Highway Traffic Safety Administration (NHTSA) and the Federal Motor Carrier Safety Administration (FMCSA) of the United States Department of Transportation (DOT).

The National Highway Traffic Safety Administration is charged with the responsibility of reducing the personal and property losses resulting from motor vehicle crashes. The goal of FMCSA is to reduce the number of commercial truck and bus crashes. Many sources of information are needed to permit researchers to adequately measure the characteristics of the highway safety environment. NHTSA's National Center for Statistics and Analysis (NCSA) operates a system of crash research teams that provide detailed nationally representative statistics on motor vehicle crashes and a database for evaluation of standards and countermeasures design.

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Cover Page Photo
Source: NHTSA/FMCSA Large Truck Crash Causation Study
Description: A chain reaction crash involving four vehicles on an urban interstate during morning daylight hours in a construction area. A 2001 Mack tractor pulling two 28-foot semi trailers struck the rear of a 1995 Volvo tractor with a 48-foot semi trailer, which struck the rear of a 1991 Honda Civic, which was pushed into the rear of a 2001 International tractor with a 48-foot flatbed trailer. All vehicle drivers sustained minor injuries except for the International tractor driver, who was not injured.

OVERVIEW

Preface

This interim report has been prepared to introduce and describe the Large Truck Crash Causation Study (LTCCS). This report discusses the background, study design, field methodology, and early data tallies for the study of large truck crashes. Description of existing data collection infrastructure is discussed to provide an understanding as to why and how this special project was conceived and designed. Preliminary tallies of the LTCCS data are presented to give an overview of the types of crashes being investigated, as well as to give an idea of future potential analyses. **However, no national estimates of proportions, relationships, or risks should be inferred from them**.

Introduction

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Background

The Motor Carrier Safety Improvement Act (MCSIA) of 1999 established the Federal Motor Carrier Safety Administration and provided the foundation for NCSA of NHTSA to provide assistance to FMCSA for collection of large truck crash data. The two agencies working together have developed the Large Truck Crash Causation Study (LTCCS), which is being conducted within the National Automotive Sampling System (NASS). Currently, no national database exists that contains information describing the causes or contributing factors for large truck crashes. The Federal Motor Carrier Safety Administration recognized the importance of having these data and began investigating methods to collect it in the fall of 1998.

LTCCS is the first-ever national study to determine the reasons and associated factors contributing to serious large truck crashes so agencies within DOT and others can implement effective countermeasures to reduce the occurrence and severity of these crashes. Teams of trained researchers from NHTSA’s NASS program and State truck inspectors are collecting nationally representative data on the primary and secondary causes of serious large truck crashes.

The MCSIA of 1999 requires FMCSA to consult on the LTCCS with persons who have expertise in crash causation, commercial and non-commercial drivers, motor carriers, motor carrier safety programs, highways, and research methods. The Transportation Research Board (TRB), under contract to FMCSA, formed an advisory committee to review the study and provide comments and recommendations.

NHTSA is authorized by Congress (Volume 49 of the United States Code, Section 30166, 30168 and Volume 23, Section 403) to collect statistical data on motor vehicle traffic crashes to aid in the development, implementation and evaluation of motor vehicle and highway safety countermeasures. NASS is the mechanism through which NHTSA collects nationally representative data on motor vehicle traffic crashes.

NASS field data collection contractors follow strict procedures during data gathering and review. Data processing contractors also follow strict procedures during file automation, editing, storage, and analysis. NASS management monitors these procedures through quality control practices, including case review, examination of the automated file, reporting and periodic field observations.

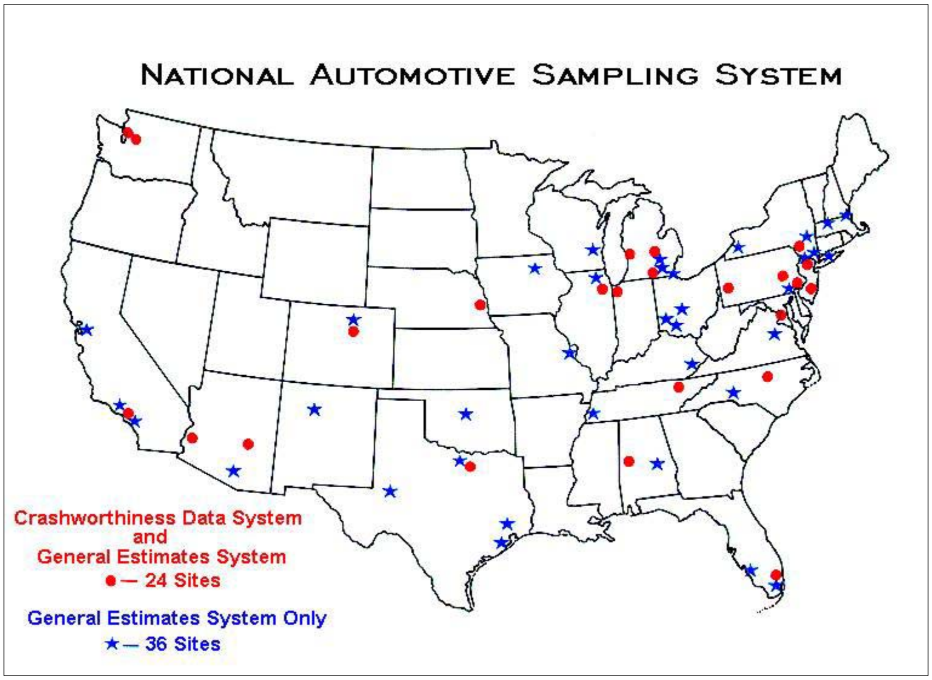
Researchers under contract to NHTSA and FMCSA-funded State truck inspectors will collect information on a sample of large truck crashes. NASS researchers depend on the voluntary participation and cooperation of law enforcement agencies, hospitals, physicians, medical examiners, coroners, tow yard operators, garages, vehicle storage facilities, and the individuals involved in crashes. Cooperation is established with police agencies and hospitals to provide copies or transcripts of official records. Tow yards, police impound yards, and crash involved parties are contacted to obtain permission to inspect vehicles. Personal or telephone contact is made with interviewees to obtain information about occupant characteristics and crash circumstances.

Regardless of the mode of data collection, the agencies and individuals are assured by the NASS researcher that any information obtained that identifies the individual will be held confidential. The preservation of the privacy of individuals is statutorily mandated. This requirement serves to ensure the public's trust in the program and enhances the researcher's ability to solicit the required information.

NASS Infrastructure

The NASS mission is to provide nationally representative data on fatal and nonfatal motor vehicle traffic crashes for use in developing and evaluating federal motor vehicle safety standards and other safety countermeasures. Originally designed and implemented in the late 1970s, NASS has re-evaluated its objectives, and since 1988, has focused primarily on passenger vehicle crash protection performance. In 1988, two components of NASS were implemented for this mission, the General Estimates System (GES) and the Crashworthiness Data System (CDS). GES is an annual representative sample of approximately 55,000 police traffic crash reports involving all types of motor vehicles from 60 sites throughout the contiguous United States (Figure 1). These sites are called Primary Sampling Units or PSUs.

Figure 1
NASS Site Locations

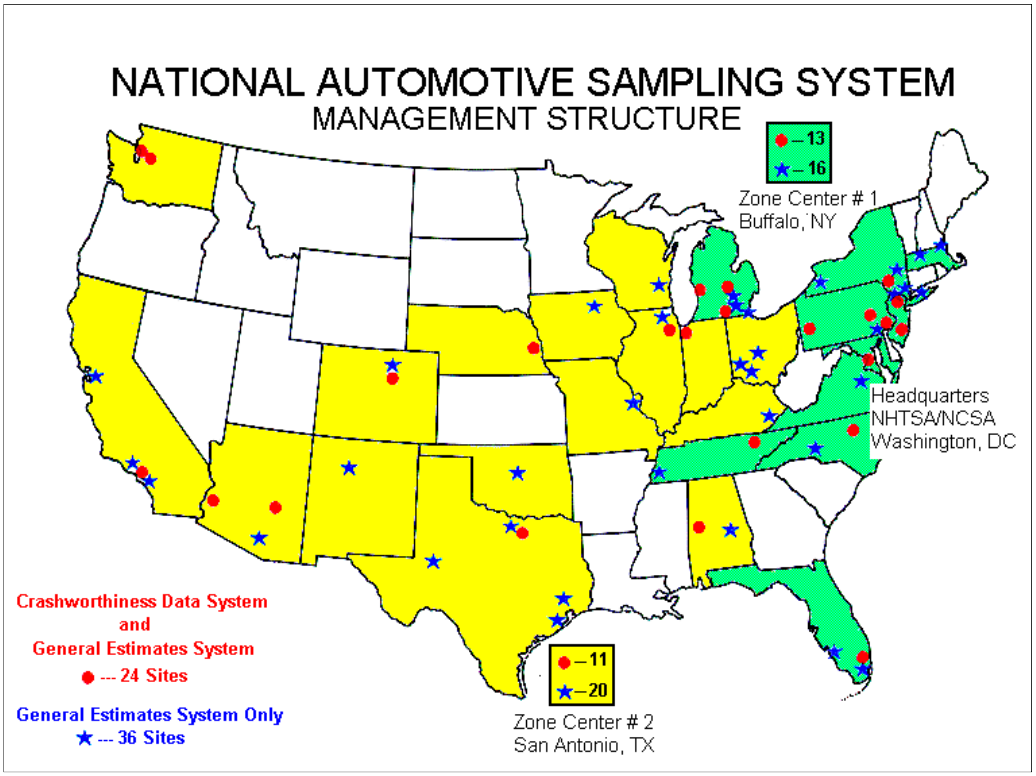


The GES database is only coded from information on the police traffic reports. CDS is an annual representative sample of approximately 4,000 police-reported traffic crashes involving passenger cars, light trucks, and vans under 10,000 pounds GVWR (gross vehicle weight rating). CDS uses 67 trained researchers to conduct detailed investigations of these 4,000 selected passenger vehicle crashes from 24 sites throughout the contiguous United States. The 24 sites in CDS are located in 17 states, and the 60 sites for GES are located in 26 states (Figure 1).

The field data collection operation of the crash research teams, maintenance of field research quality, and technical guidance for each PSU are the primary responsibilities of two contractors. These contractors are referred to as Zone Centers (Figure 2). Zone Centers serve as resource centers providing the teams with expert technical guidance in crash investigation. The Zone Centers monitor closely the performance and productivity of each PSU under close supervision by NHTSA. NHTSA has overall policy and administrative management of the project.

NASS was selected for this study because: it has been designed to provide nationally representative data randomly selected from police traffic crash reports; it provides quality assurance at multiple levels to ensure data completeness, accuracy, reliability, consistency, and timeliness; it offers quality assurance to identify trends and problems in field data collection methods; it offers quality assurance to identify, measure, and control errors; it has an established training program to teach the basics of crash investigation, to improve data collection skills, and provide remedial training; the data collected are kept confidential to ensure the public trust and enhance the program's ability to solicit required information from crash victims; and, the data are publicly made available for others to clinically review and analyze.

Figure 2
NASS Management Structure



The NASS infrastructure has the capability to establish operational procedures at multiple locations, promote rapid start-up procedures for special data collection efforts, provide real-time investigations, and release timely reports of crash data. The NASS program has been in existence for over two decades and operationally has developed experience in the establishment and maintenance of close relationships between local agencies. NASS has also established cooperation with many organizations such as law enforcement, vehicle tow yards, hospitals, coroners, medical personnel, insurance companies, and traffic safety groups. This experience has helped successfully launch and conduct unique studies such as the large truck crash causation study. Past studies conducted in NASS include anti-lacerative windshields, automatic occupant restraint systems, pedestrian crashes, vehicle fires from crash impacts, unsafe driver actions, run off the road crashes, new generation air bags, truck underride, center high-mounted rear stoplights, and tire pressures.

FIELD DATA COLLECTION METHODOLOGY

There were a number of issues/concerns associated with the proposed large truck crash causation study. It has been documented in preceding crash investigation efforts[1] that large trucks tend to be moved from the immediate vicinity of the crash site in a relatively short time frame. This is particularly evident in circumstances where a national or regional carrier owns the commercial vehicle. These units tend to be moved to regional repair centers either to be repaired and placed back in service or to be stripped for parts. Given this tendency, it was critical to program success to initiate investigation activities relatively quickly following the crash occurrence.

An on-scene investigation response protocol was developed, as opposed to a reactive approach (follow-on investigation), to meet the large truck study requirements of gathering in-depth crash related data in a timely manner. Since the start of this study, experience has shown that the availability of crash data often diminishes with the passage of time. When the case investigation is initiated one to several days after the crash, vehicles towed from the scene tend to be more difficult to locate, and when located, frequently are undergoing repair, have been repaired, or have been processed through salvage. In the case of interstate trucks, this situation is further complicated by the transient nature of these vehicles, as the potential for them to leave the area before being inspected is understandably high.

On-scene presence by the NASS truck researcher and State truck inspector provides the capability to obtain vehicle and interview data that may not have been available in a reactive post-crash environment. As an example, the overall length of the vehicle (total length of the vehicle including projections beyond the front and rear planes) is more accurately measured in the field than obtained later from other sources. Interviewee responses to questions tend to be less biased at the scene than away from the scene. Another advantage of on-scene presence is the opportunity to establish a rapport with the interviewee at the scene, which makes it possible to conduct a more in-depth follow-up interview.

It is noteworthy that the on-scene investigative approach signifies the first time in NASS history (and perhaps in the history of crash data studies) that police investigators, certified Commercial Vehicle Safety Alliance (CVSA) Level 1 State truck inspectors, and NASS truck researchers have combined their efforts and agreed to simultaneously respond to a crash scene. This unique arrangement, although initially thought to be difficult to achieve, has developed into a first rate network among on-scene responders, yielding several important results. These results include a higher rate of participation by crash victims, a higher quality of interview and vehicle information, and a better understanding of the crash events. Additionally, these results have been achieved without compromising enforcement rules or research protocols. The police and CVSA State truck inspectors have maintained their responsibility for enforcing traffic laws and safety regulations while NASS has maintained its obligation of ensuring research data confidentiality.

[1] Tharp, K.J. and Garrett, J.W., “Multidisciplinary Investigations to Determine Automobile Accident Causation: Organization and Methodology of Intensive Accident Investigation”, Calspan Corporation (formerly Cornell Aeronautical Laboratory, Inc.), prepared for Automobile Manufacturers Association, CAL No. VJ-2224-V-1, 1968

Investigation Team Structure

A team of two individuals completes the investigation protocol utilized for each crash in this study. Primary responsibility for each investigation is assigned to the NASS truck researcher at the designated data collection site. A certified State truck inspector who completes a limited number of investigation activities assists this individual. Since these individuals are not at the same office location, the NASS truck researcher is assigned responsibility for tracking the location of the truck unit(s) and for contacting the appropriate State truck inspector. If the truck inspection cannot be conducted at the crash scene with the State truck inspector, then the NASS truck researcher will make arrangements for completion of the truck inspection sequence at an alternative location.

Team Data Collection Responsibilities

Responsibility for data collection is summarized in Table 1. The NASS truck researcher is assigned primary responsibility for case completion. The role of the State truck inspector is to complete the North American Level 1 truck inspection sequence and secure the cooperation of truck drivers and trucking companies in completing required interview sequences. Information collected by the NASS truck researchers is not shared with the State truck inspectors in order to maintain the separation between a researcher study and law enforcement responsibilities.

In addition to these specific responsibilities, the NASS truck researcher monitors the post-crash location of the large truck unit(s) and coordinates the Level 1 inspection sequence with the State truck inspector. The NASS truck researcher is also present for the inspection sequence and secures photographic documentation of relevant inspection findings.

Table 1
Team Data Collection Responsibilities

NASS Truck Researcher	State Truck Inspector
• Document physical evidence at scene • Perform all non-commercial vehicle inspections • Document commercial vehicle damage • Conduct all driver and witness interviews • Conduct all trucking company interviews • Acquire medical reports • Acquire police crash report • Complete forms • Submit case materials	• Interact between police and NASS truck researcher • Conduct Level 1 truck inspection • Inspect truck driver log book • Secure permission, if necessary, from police officer at scene to inspect truck • Facilitate communication between truck driver and trucking company with NASS truck researcher • Provide on-scene photographs if taken by inspector/police

On-Scene Investigation Sequence

Upon arrival at the crash site, the NASS truck researcher and State truck inspector introduce themselves to the investigating police officer and obtain permission to be on-scene. The NASS truck researcher has been instructed not to interfere with the ongoing police investigation until he/she has been authorized by the investigating officer to begin the NASS data collection. In most cases, however, the police have been very accommodating and have allowed the NASS truck researcher to begin their investigation without delay.

The sequence of data collection activities varies from crash to crash and is dependent upon the number of vehicles and participants involved, and the amount of time available before the crash scene is cleared. The NASS truck researcher is required to obtain a set of digital images of the scene with emphasis on precrash vehicle trajectory, impact, and final rest position(s). These images provide crucial data that are used in the assessment of crash events. Additionally, views of the involved vehicles are very important as the vehicles, especially interstate vehicles may not be available after the scene is cleared. Areas of photographic interest include alleged mechanical defects (e.g., degraded brake hoses, worn reflective tape, defective tires, suspension defects, etc.), location and severity of vehicle damage, vehicle placard information (e.g., Gross Vehicle Weight Rating (GVWR), Vehicle Identification Number (VIN), etc.), and overall vehicle exterior and interior views.

The NASS truck researcher works with the State truck inspector and observes the vehicle inspection process, including the review of mechanical components (e.g., brake stroke measurements, suspension, lighting, reflective tape, tires, etc.), observes the types of cargo loads and loading pattern, and reviews the driver logs. Any vehicle defects noted by the State truck inspector are reported to the NASS truck researcher and recorded on data collection forms (see Appendix). The NASS truck researchers have attended the intensive Commercial Vehicle Post Crash Inspection Training Course (T.E.A.M.- Training Expertise in Accident Management) to gain an appreciation of truck regulations that has helped when interacting with the State truck inspectors. Likewise, many State truck inspectors have attended the NASS truck study training to gain an appreciation of program requirements. The purpose of this cross training was to help understand the responsibilities of each at the crash scene and to build relationships between researchers and inspectors.

Scene evidence documentation is another priority and is best obtained while on-scene. Researchers have noted that physical evidence captured in on-scene photography has degraded or vanished when they returned for follow-up investigation. Researchers are required to document pre-impact tire marks (e.g., skid marks, yaw marks, etc.), the point of impact(s), and final rest positions of vehicles. They also document several key items including roadway design, traffic control devices, environmental conditions, and sightline restrictions. Many of these tasks understandably require considerable time to complete and often require a return visit after the scene is cleared.

Interviewing crash participants is clearly the most important aspect of the LTCCS. During an on-scene investigation, the NASS truck researcher conducts interviews with the truck driver(s), the other driver(s), and any witnesses to ascertain precrash events. Given the fact that agreeing to an interview is a voluntary act by the interviewee, the researchers have noted that the presence of law enforcement officials has helped them in gaining acceptance by the interviewee. Police and State truck inspectors have generally taken an active role in supporting this research effort and encourage participants to discuss the crash events with the NASS truck researcher.

Unfortunately, there has been a small number of crash participants who were unwilling to discuss precrash events with the NASS truck researcher while on-scene, especially when criminal charges were pending or where the driver (in the case of a truck driver) has been instructed by the carrier not to discuss aspects of the crash. Even in those circumstances, the NASS truck researcher has been able to glean information from the participants just by being in the vicinity and listening to statements as they are given to other individuals.

The NASS truck researcher has also been trained to observe driver behavioral patterns for indications of fatigue (e.g., speech pattern, the driver's posture, blood shot eyes, etc.). This was exemplified in one crash where the truck driver indicated that he had sufficient sleep and claimed he had encountered mechanical difficulties resulting in the crash. His initial statement appeared compelling, but it began to unravel as he was observed dozing while waiting in the police car. This and other data in this particular case indicated that the driver had fallen asleep prior to departing the roadway.

In some cases, the crash participants have been removed from the scene and transported to medical treatment facilities. The NASS truck researcher subsequently visits the medical facility and attempts to obtain an interview. In most cases, the interviewee is very cooperative as the person realizes that the NASS truck researcher does not pose a legal threat.

Another feature of on-scene interviewing technique is the use of a portable tape recorder. This device has helped the NASS truck researcher record interview information in a way that streamlines the interview process. The researcher is able to conduct a dialogue with the interviewee and ask probing questions without having to interrupt the flow by writing answers on paper. It has also provided a means for the researcher to improve his/her interviewing skills through review of the tapes and also for Zone Center case reviewers to assess the quality of the information.

Field data collection forms were designed to record data in an efficient manner and to provide a guideline for the NASS truck researcher. The NASS truck researcher attempts to complete all relevant forms at the scene, however, information that cannot be obtained on-scene is obtained as soon as possible afterward. A compact disc provided with this report contains the full set of field data collection forms and manuals used in this study.

Modification of Current Cooperative Agreements

Currently, cooperative agreements with police jurisdictions exist because of the infrastructure established by NHTSA to conduct the NASS program. These agreements had to be modified in order to conduct the study requirements of this large truck crash causation study. Successful completion of the truck study required that the investigation teams receive timely notification of the crash occurrence from the local police jurisdictions. This is necessary to ensure that truck documentation protocols can be completed before the unit is removed from the immediate vicinity of the crash site. New cooperative agreements with participating police agencies have been negotiated to include securing direct notification of a crash occurrence. The team must respond rapidly to the crash site while the vehicles are on scene to obtain critical evidence before it disappears. It is advantageous to begin documentation procedures soon after the crash incident.

In addition to providing crash notification, the cooperative agreements with the local police provide the names of applicable towing agencies and the intended destination of at least the truck unit from the dispatcher or responding officer. Upon receipt of notification, the NASS truck researcher contacts the intended destination site of the truck unit and schedules vehicle inspection activities.

This study needed well-established cooperative agreements with State truck inspectors and other local police agencies in order to collect the data needed for the project. The procedures used to establish cooperation with federal, state, and local officials for LTCCS were:

1. Develop Procedures for Establishing Cooperation - Due to the large number of government agencies involved in the Large Truck Crash Causation Study, a multifaceted approach was developed to establish cooperation. The main strategy was to use previously established lines of communication and contacts to open new doors (e.g., use FMCSA Division Office to contact State Motor Carrier Safety Assistance Program [MCSAP] Agency). Responsibilities for the various tasks were distributed to FMCSA, NHTSA, and the NASS Zone Centers.

2. Develop a Contact List - FMCSA produced a table naming the FMCSA State Directors and individuals at the State MCSAP agencies. The Zone Centers provided a list of other police agencies operating in the study areas. These lists were distributed to FMSCA, NHTSA, and the Zone Centers.

3. Contact Agencies - As developed in item 1, establishing cooperative agreements at all involved agencies was initiated. Typically, there were five or more different agencies types involved. They included:
    - Federal Motor Carrier Safety Administration,
    - National Highway Traffic Safety Administration,
    - Federal Motor Carrier Safety Administration Division Office,
    - State MCSAP Agency, and
    - Other Local Police Agencies.

   FMCSA contacted their State Division Administrators (DAs) to explain the LTCCS and told them to expect contact from a NASS Zone Center representative. Each Zone Center contacted their respective State DA and arranged a local meeting. State MCSAP agencies were contacted by their FMCSA State DA and invited to the meeting.

4. Arrange Meeting - The Zone Centers found a date convenient to all parties and made plans for the meeting. Meetings were held from March to October 2000. An agenda and

meeting logistics were sent to all participants.

5. Conduct Meeting - The meetings usually involved ten or more people, meeting in a local conference room. The attendees included an FMCSA and/or NHTSA representative, state FMCSA and MCSAP agency personnel, Zone Center staff, and local NASS staff.

   Formal presentations were made to introduce NASS and the LTCCS. The agenda used at one of these meetings is presented in Figure 3. Round table discussions followed the formal presentations. All agencies were very cooperative and worked together to resolve procedural matters and other concerns. These meetings were always very friendly, open, and enjoyable. In most cases, full cooperation was established by the conclusion of the meeting, only leaving operational details to be worked out.

6. Resolve Outstanding Issues and Document Results - Some meetings ended with outstanding issues to resolve. Follow-up phone calls, e-mails, and in-person meetings were conducted as needed. In one state, NHTSA and the Zone Center had to negotiate and sign a Memorandum of Understanding with the MCSAP agency in order to establish an agreement. The Zone Centers documented all details of the cooperative agreements, including lines of communication and notification details.

7. Contact Other Involved Agencies - The final step involved contacting and establishing cooperation with other police agencies operating within the study boundaries. The Zone Centers used their established NASS contacts and/or local MCSAP agency to help upgrade cooperative agreements.

Notification Criteria

One important part of the notification process is how to determine eligible crashes. Trucks involved in the crash must be greater than 10,000 pounds and the crash must result in a police-reported injury level of “K”, “A”, or “B”. Threshold vehicle types like the Ford F350 and F450 can be difficult to categorize, however, pickup trucks above the F350 series and similar trucks from other manufacturers are eligible for this study. Injury levels are defined on police reports by the standard KABCOU injury-coding scheme. Police officers or State truck inspectors responding to the scene visually define injuries as “K” for killed, “A” for incapacitating injury, “B” for evident but non-incapacitating, “C” for possible injury or complaint of pain, “O” for no injury, and “U” for injury status unknown. Definitions of injuries are in the appendix glossary. Determining the injury level at an on-scene crash can be difficult for the responding police officer or State truck inspector and becomes a judgmental issue as to whether or not to notify the NASS truck researcher. When injury classification at the scene is difficult, the NASS truck researcher may follow the victim to the hospital to better evaluate the injury level before determining its eligibility.

Figure 3
LTCCS Cooperation Meeting Agenda

Large Truck Crash Causation Study (LTCCS)
Federal Motor Carrier Safety Administration (FMCSA)
National Highway Traffic Safety Administration (NHTSA)
National Automotive Sampling System (NASS)

Meeting Place
250 W. 24th Street, Suite B
Yuma, AZ 85364
(520) 782-6268

Meeting Date/Time
Monday, March 27, 2000
10 AM to 3 PM

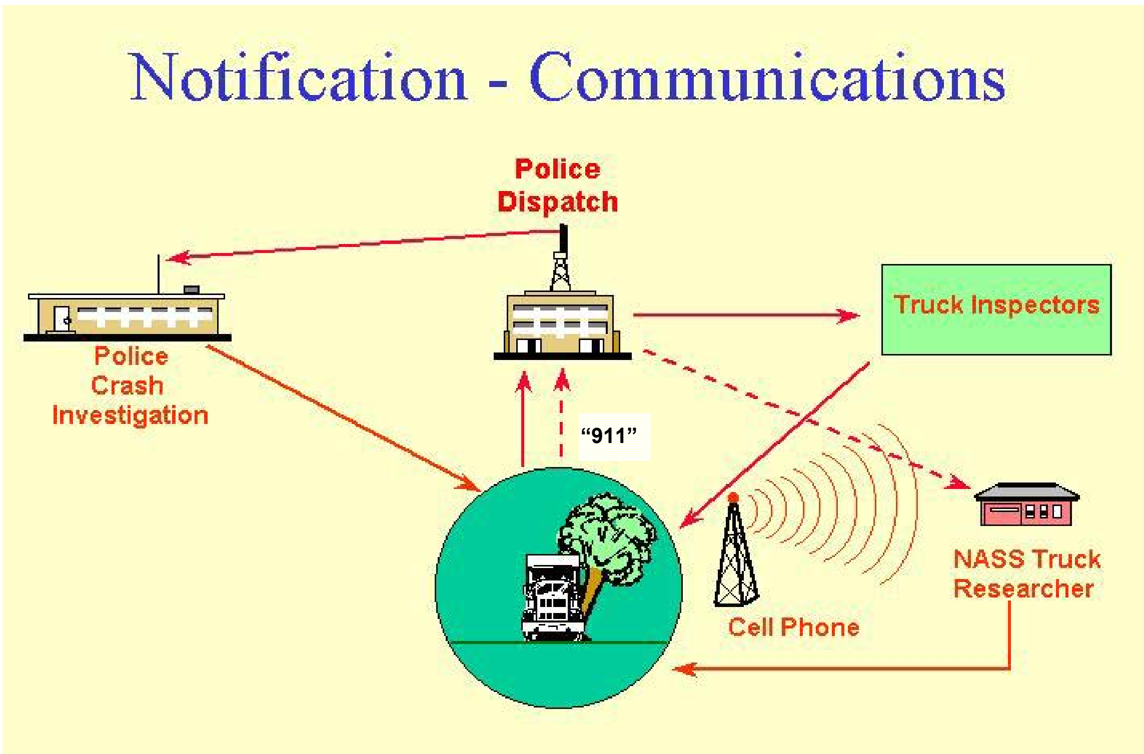
Attendees
Ralph Craft, FMCSA Washington, D.C.
Gary Toth, NHTSA Washington, D.C. (Via telephone)
Eric Ice, FMCSA Arizona State Director, Phoenix, AZ
Alan Vitcavage, FMCSA, Phoenix, AZ
Lt. Mike Lockhart, Officers Chris Mueller, Jack Owens, Tom Hash, and Dave White, Arizona Department of Public Safety
Steve Mavros, NASS Zone Center Manager, San Antonio, TX
Tom Swiercinsky and Frank Meyer, NASS Zone Center, San Antonio, TX
Mike Johnson, NASS PSU Team Leader, Yuma, AZ

Agenda
- Introductions
- Overview of NASS CDS objectives and operations
- Overview of LTCCS objective
- Discussion of LTCCS operations
- What vehicles are eligible?
- Data collection requirements
- NASS truck researcher responsibilities
- State truck inspector responsibilities
- Training requirements
- Project time schedule
- Crash notification
- On-scene response
- Question and answer
- Summary of action items and final comments

Notification Process

Figure 4 graphically represents a general description of the notification and communication network developed for the large truck crash causation study. A typical scenario is once a crash occurs the police dispatcher is usually notified through “911”. The police dispatcher alerts the police officer on-duty who responds to the scene. The responding police identify the involvement of a large truck and report back to the police dispatcher. The police dispatcher calls

Figure 4
Notification/Communication Process



a State truck inspector who also responds to the scene of the crash. The eligibility of a crash for LTCCS is determined by the State truck inspector who calls the NASS truck researcher via a cell phone about the eligible crash. The NASS truck researcher responds to the scene as soon as possible.

Another typical scenario is the police dispatcher will notify the State truck inspector and NASS truck researcher at the same time and both will respond as soon as possible to the crash scene. Several other variations of this process exist in the field. The NASS truck researcher may be the pivotal point of contact and alert the State truck inspector of a potential crash, or bypassing the police dispatcher, the responding police officer may notify the NASS truck researcher and/or State truck inspector. Other atypical sources of crash notification also exist. The NASS truck researcher may be notified through other outside sources such as media, personal observation or other team members using police scanners.

NASS truck researchers are available 24/7 (24 hours a day, 7 days a week) except at locations where more than 80 crashes are expected to occur annually. If more than 80 crashes are expected, then an alternative plan will be designed to randomly select eligible crashes. At one study site, because of the high volume of eligible truck crashes, every other crash is selected. State truck inspectors are not on-call 24/7. They typically work shifts and there may be blackout periods where no State truck inspector is available. Regardless of the State truck inspectors' duty hours, the NASS truck researcher, if notified, will respond as quickly as is feasible.

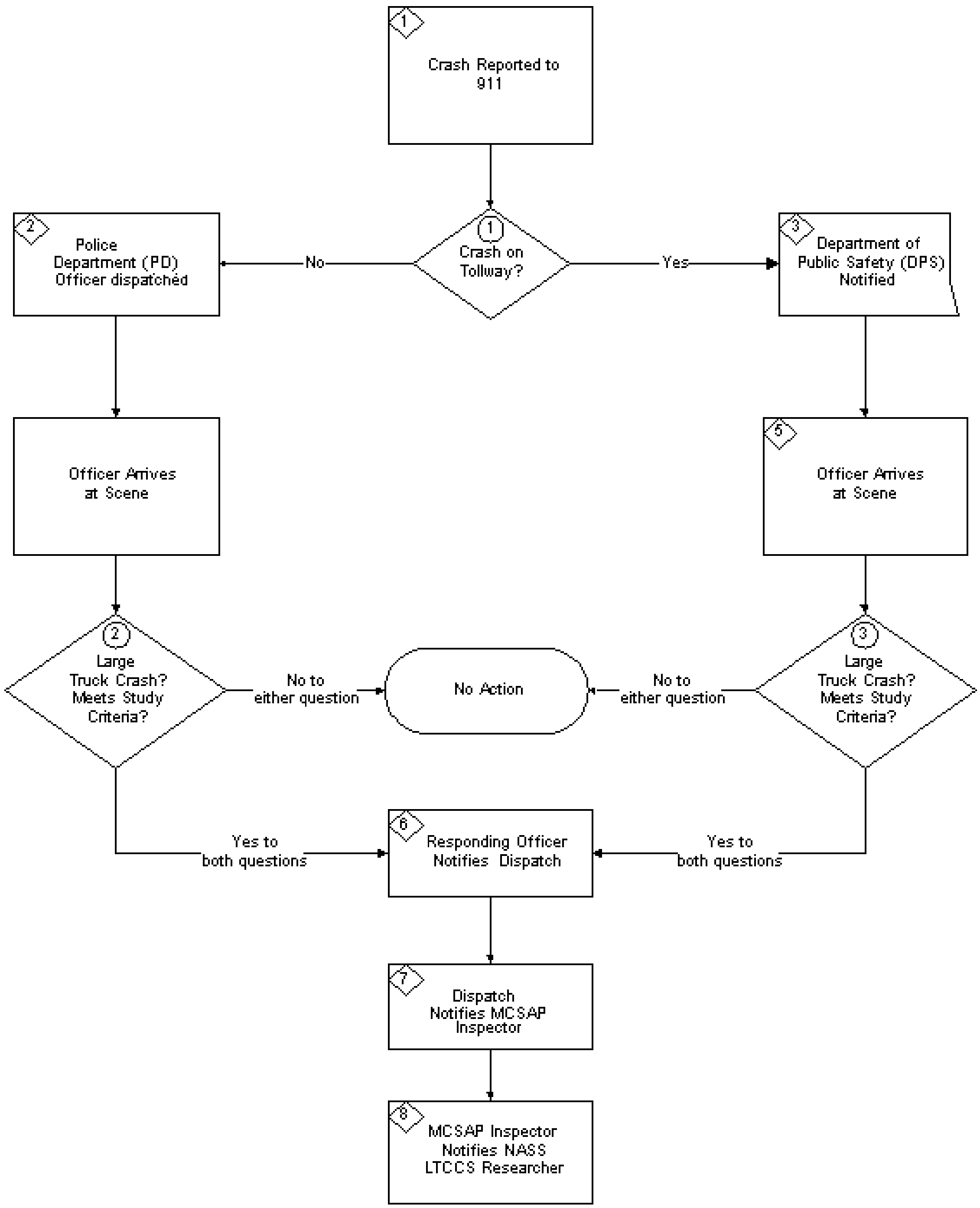
Rapid notification of a crash is a process that requires continuous maintenance and quality control oversight. Every participant in the process requires reminders as to whom to call when certain crash criteria are met. Notification is a real-time event that demands an immediate decision by a police officer to screen the eligibility of a crash. For quality control purposes, the NASS Zone Centers constantly monitor how the notification process is functioning. It is the responsibility of each NASS truck researcher at each data collection site to list every large truck crash that is submitted to the police jurisdiction. A review of each large truck crash is made to determine if it met the criteria of this study. This list of eligible crashes is then compared to a list of on-scene notifications received by the NASS truck researcher through the established notification process. Tables 2 and 3 show the comparison between all crashes involving large trucks, eligible truck crashes, and notifications received by the NASS truck researchers from January 2001 through August 2002 for all data collection sites. It is important to remember that determination of eligible truck crashes is a paper-tracking exercise that occurs after the police report has been received at the police jurisdiction, whereas, notification is a real-time occurrence. When it is determined that the NASS truck researcher did not receive notification of an eligible truck crash, the flowchart of the notification structure at that site is reviewed and evaluated as to why the process was not successful. Based on results of each crash missed, attempts are made to improve the notification process. Figure 5 is a flowchart that graphically represents the actual notification process for a current LTCCS team with two police jurisdictions.

Notification involves the cooperation of hundreds of State and local police in the PSUs. In some urban sites only two police agencies exist, the State police and the city police. At the other extreme, one PSU at a suburban location has over 110 local police agencies, including the State police responsible for the turnpike and other major highways. Even where there are few police agencies, there are sometimes several police dispatch centers. Establishing and maintaining the cooperation of police dispatch personnel has been a major field operational challenge.

Table 2 LTCCS Notifications and Cases Initiated for Pilot Study Phase				
Month and Year	Listed Large-Truck Crashes	Eligible Truck Crashes	Notifications	
			Count	% of Eligible Truck Crashes
January 2001	742	79	34	43
February 2001	780	91	31	34
March 2001	950	112	36	32
April 2001	1065	126	46	37
May 2001	1039	130	44	34
June 2001	835	110	54	49
Total	**5,411**	**648**	**245**	**38**

Table 3 LTCCS Notifications and Cases Initiated for Regular Data Collection				
Month and Year	Listed Large-Truck Crashes	Eligible Truck Crashes	Notifications	
			Count	% of Eligible Truck Crashes
July 2001	962	120	27	23
August 2001	990	120	39	33
September 2001	895	93	27	29
October 2001	1211	104	50	48
November 2001	665	57	34	60
December 2001	738	96	35	36
January 2002	627	91	47	52
February 2002	734	75	49	65
March 2002	879	104	63	61
April 2002	996	95	65	68
May 2002	1033	120	51	43
June 2002	547	95	44	46
July 2002	1073	125	44	35
August 2002	910	118	57	48
Total	**12,260**	**1,413**	**632**	**45**

Figure 5
Notification Process
Example of Two Police Jurisdictions



Constant reminders of the ongoing study are sometimes necessary to police officers and dispatchers about the presence and requirements of this special program. Laminated cards called pinch cards (Figures 6 and 7) have been developed that list details about the truck study and have been distributed among law enforcement personnel. On occasion, the NASS truck researcher will attend roll call meetings at local police jurisdictions to briefly describe the study, which keeps the program activities fresh in their minds.

Figure 6
"Pinch Card – Front"

Large Truck Crash Study

Does the crash meet the following criteria?

- **Is a Truck or Parcel Van Involved in the Crash?**
- **Is there Injury to Anyone Involved in the Crash?**

If the answer is YES to both of these questions, call Highway Patrol Communications at (919) 733-3861

☆ See back for included truck types and injury levels ☆

NHTSA People Saving People

NASS

FMCSA Federal Motor Carrier Safety Administration

Figure 7
"Pinch Card – Back"

Truck Types

Includes

☆ Any truck larger than a pickup truck
☆ Parcel vans (FedEx, UPS, etc.)
☆ Government & municipal trucks or parcel vans
☆ Military cargo or troop transport trucks

Excludes

☆ Pickup trucks (Ford F150, F250, F350, GMC C1500, C2500, C3500, etc.)
☆ Buses
☆ Rescue vehicles (fire truck, ambulance, etc.)
☆ Road construction vehicles (backhoe, etc.)
☆ Farm tractor
☆ Military vehicles not designed to carry cargo or troops (tanks, etc)

Injury Information

☆ Any injured person involved in the crash, including pedestrians
☆ Any person transported to a medical facility
☆ Fatal Injury
☆ Severe injury [fractures, unconsciousness, etc. (incapacitating injury)]

Sample Design of LTCCS

The crashes investigated for the LTCCS are a probability sample of all large truck crashes in which at least one person was killed or injured in the United States. Using the infrastructure of the National Automotive Sampling System Crashworthiness Data System (NASS CDS), the number of crashes involving at least one large truck and at least one person involved was killed or injured can be estimated. Standard errors associated with these national estimates will be computed. The selection of crashes for the LTCCS will be accomplished in two stages. The first stage is the selection of geographic areas called primary sampling units (PSUs). The United States has been divided into 1,195 PSUs where each PSU is comprised on a large city, a county, or a group of counties. The PSUs are grouped into 12 categories described by geographic region (northeast, midwest, south, west) and degree of population (central city, large county, and group of counties). Two PSUs were selected from each category with probability proportional to its 1983 population. The four geographic regions are shown in Table 4.

Table 4
LTCCS Sample Locations by Region

GEOGRAPHIC REGION	**Northeast**	New Jersey – Ocean County New York – Kings County (Brooklyn) New York – Ulster County Pennsylvania – Allegheny County (except Pittsburgh) Pennsylvania – Montgomery County Pennsylvania – Philadelphia
	Midwest	Illinois – Chicago Indiana – Lake County Michigan – Genesee County Michigan – Muskegon County Michigan – Washtenaw County Nebraska – Douglas County
	South	Alabama – Bibb and Tuscaloosa Counties Florida – Fort Lauderdale and Hollywood Maryland – Charles and Prince George’s Counties North Carolina – Wake County Tennessee – Knox County Texas – Dallas
	West	Arizona – Gila, Graham, and Greenlee Counties Arizona –Yuma and La Paz Counties California – Los Angeles Colorado – Gilpin and Jefferson Counties Washington – King County (except Seattle) Washington – Seattle

Since the majority of the PSUs will investigate all of the qualifying large truck crashes that occur within their area, the national estimate for these crashes is obtained by weighting each crash in the PSU by the inverse of the probability of the selection of the PSU.

For those PSUs that have too many crashes to investigate, a sample of qualifying large truck crashes will be selected. That is, for every nth qualifying crash that the PSU is notified of, one crash will be selected for investigation. The nth crash is called the interval. This is the second stage of the sample design. The national estimate for these crashes is equal to the product of the interval and the inverse of the probability that the PSU was selected.

The crashes eligible for the LTCCS are identified at the on-scene investigation. Therefore, it is critical that the NASS truck researcher at the PSU must be notified by the police that a qualifying large truck crash occurred. Unfortunately, the NASS truck researcher is not always notified that a large truck crash occurred as shown in Tables 2 and 3. Therefore, to adjust for the non-notified LTCCS crashes, the national estimate for each crash will be multiplied by an adjustment factor. The adjustment factor is equal to the number of qualifying large truck crashes listed by the PSU divided by the number of crashes selected. The adjustment factor also will be applied to those situations in which notification at a particular PSU was not available for a period of time or the truck researcher resigns.

Data Collection Elements

The sources for the information collected in this study come from the North American Standard Level 1 inspection report completed by State truck inspectors for the truck and truck driver, the police crash report, researcher's reconstruction data, interviews, medical reports, motor carriers, and any other data source that can contribute to the understanding of the crash events and circumstances.

Field data collection forms (Appendix) were designed to record data in an efficient manner and to provide a guideline for the NASS truck researcher. Forms taken on-scene include: Collision Diagram Measurement Table, General Vehicle Form, Exterior Truck Form, Exterior Vehicle Form, Truck Driver Interview Form (A), Surrogate Truck Interview Form (A), Other Driver Interview Form (B), Surrogate Other Driver Interview Form (B), Motor Carrier Interview Form (C), Witness Interview Form (D), and Nonmotorist Interview Form (E). The NASS truck researcher attempts to complete all relevant forms at the scene. Information that cannot be obtained on-scene will be obtained as soon as possible after the crash occurrence.

A general outline of data elements contained in each data collection form is listed below by category. A complete set of the forms and manuals is available on the compact disc attached to this report.

- **General Crash Data**
  - Crash Summary Description
  - Identification
  - List all Crash Events

- **Collision Diagram Measurement Table**
  - Document physical plant
  - Document vehicle dynamics

- **Collision Diagram**

- **General Vehicle Data**
  - Vehicle Identification
  - Official Records
  - Pre-crash Environmental Data
  - Vehicle/Cargo weight
  - Rollover Data
  - Fire Occurrence
  - Underride/Override Occurrence

- **Exterior Truck Data**
  - Vehicle Identification
  - Cargo Information
  - Truck Conspicuity
  - Exterior Mirror Data
  - Crush Measurements
  - Vehicle Damage Sketch
  - Level 1 Inspection Results

- **Interior Truck Data**
  - Truck Occupant Contact Sketch
  - Points of Truck Occupant Contacts

- **Interview Forms for Truck Drivers and Other Drivers**
  - Driver's Description of Crash Events
  - Occupant's Description of Crash Events
  - Crash Data Driver Related Data
  - Rollover Data
  - Fire Data
  - Jackknife Data
  - Cargo Shift Data
  - Fatigue Issues
  - Driver Physical Condition
  - Inattention/Distraction Issues
  - Perception/Decision Issues
  - Aggressive Driving Issues
  - Trip Related Data
  - Vehicle Related Data
  - Occupant Data Questions
  - Restraint Information
  - Ejection, Entrapment, Mobility Information
  - Injury Information

- **Interview Form for Motor Carriers**
  - Carrier Information Vehicle Information
  - General Driver Information
  - Detailed Crash-Involved Driver Information
  - Crash Trip Information

- **Interview Form for Witness**
  - Description of Crash Events
  - Crash Data Information

- **Interview Form for Nonmotorist**
  - Description of Crash Events
  - Nonmotorist Demographic Data
  - Crash Data Information Physical Condition
  - Fatigue Issues
  - Inattention/Distraction Issues
  - Decision Issues
  - Performance Issues
  - Injury Information

- **Occupant Assessment Data**
  - Occupant Characteristics
  - Seating
  - Ejection/Entrapment
  - Belt System Function
  - Police Reported Restraint Use
  - Air Bag System Function
  - Injury Consequences
  - Trauma Data
  - Belt Use Determination

- **Occupant Injury Data**
  - Source of Injury
  - Body Region
  - Type of and Specific Anatomic Structure
  - Level of Injury
  - AIS Severity
  - Aspect
  - Injury Source
  - Injury Source Confidence Level
  - Direct/Indirect Injury
  - Injury Intrusion Related

- **Crash Event Assessment Data**
  - Precrash Event Related Data
  - Key Precrash Event Characteristics
  - Critical Event Associated Factor Support Data
  - Driver Related Physical Factors
    1. Alcohol Use
    2. Illegal Drug Use
    3. Over-the-Counter Medication Use
    4. Prescription Medication Use
    5. Driver Fatigue
    6. Illness
    7. Vision
  - Driver Related Recognition Factors
    1. Inattention
    2. Conversation
    3. Other Non-Driving Activities
    4. Exterior Factors
    5. Inadequate Surveillance
  - Driver Related Decision Factors
    1. Following Too Closely
    2. Misjudgment of Gap Distance to Other Vehicle
    3. False Assumption of Other Road User's Actions
    4. Illegal Maneuver
    5. Inadequate Evasive Action
    6. Aggressive Driving Behavior
  - Driver Related Emotional Factors
    1. Driver Was Upset Prior to Crash
    2. Driver Under Work-Related Pressure
    3. Driver Was in a Hurry
  - Driver Related Experience Factors
    1. Vehicle Familiarity
    2. Roadway Familiarity
  - Relation with Carrier/Employer Factors
    1. Under Pressure To Accept Loads
    2. Under Pressure To Operate
  - Traffic Flow Related Factors
    1. Traffic Flow Interruption Factors
  - Vehicle Factors
    1. Vehicle Condition Related Factors
  - Environmental Related Factors
    1. Roadway Related Factors
    2. Weather Related Factors

Post-Crash Activities

After the data have been electronically entered into the LTCCS database, the case information is forwarded to the Zone Center where experienced staff determine the crash event assessment for the crash occurrence, injuries sustained by occupants of all involved motor vehicles, sources for those injuries, and speed reconstruction.

The crash event assessment for a crash occurrence consists of three elements for each vehicle involved in the crash: the “critical precrash event”; the “critical reason for the critical event”; and “associated factors”. Data collected and coded on the vehicle level can be analyzed in many different ways, including the crash level and/or the truck level.

The “critical precrash event” is the action or event that placed the vehicle on a collision course such that the collision was unavoidable given reasonable driving skills and vehicle handling. In other words, the “critical precrash event” makes the crash inevitable. The “critical precrash event” is typically coded in relation to a pedestrian, nonmotorist, object, other motor vehicle, or animal that the subject vehicle was attempting to avoid. It is important to note that culpability/fault is not considered when making the “critical precrash event” determination.

The “critical reason for the critical event” is the immediate reason for this event and is often the last failure in the causal chain (i.e., closest in time to the “critical precrash event”). This variable establishes the critical reason for the occurrence of the critical event. Although the critical reason is an important part of the description of crash events, it is not the cause of the crash nor does it imply the assignment of fault. The primary purpose for the “critical reason for the critical event” is to enhance the description of crash events and allow analysts to better categorize similar events.

NASS truck researchers collect a wide range of data on the presence of “associated factors” in the crash. Associated factors can be related to driver physical factors, driver recognition factors, driver decision factors, driver emotional factors, driver experience factors, relation with carrier or employer, traffic flow, vehicle condition, or environment. In some cases, the presence of a particular factor may be ambiguous. Therefore, the observation of the driver by the NASS truck researcher at the scene before, during, and after the crash is critical to the identification of many “associated factors”. Identifying factors are important in order to provide additional information about the crash so that it can be described completely and hypotheses created that are related to crash risk.

Current Status Report

This three-year study consists of three phases: six months for preparation and pilot testing; two years for field data collection; and, six months for completion and analysis. The pilot test began in January 2001 and ended June 30, 2001. Cases from the pilot test continue to be updated as variables are added and improvements to the system are implemented based on recommendations from the TRB advisory committee. Since field operations went smoothly at the end of the pilot study, the regular data collection phase of LTCCS began on July 1, 2001.

During the first eighteen months of the study, fieldwork has been delayed at some locations because of the slow process to establish and maintain cooperation with a multitude of agencies, attrition of field personnel, illness, and tragic events. At the end of August 2002, 17,671 crashes involving large trucks occurred at all 24 study locations. Of these large truck crashes, 12 percent (2061 crashes) satisfied the study criteria. Active NASS truck researchers received notification on 5 percent (877 crashes) of the large truck crashes and initiated investigations on 71 percent of those notifications (622 crashes).

EARLY CASES --- PRELIMINARY TALLIES

Preliminary tallies of the LTCCS data are presented here to give an overview of the types of crashes being investigated, as well as to give an idea of future potential analyses. Out of the many variables being collected, a few were chosen to demonstrate the level of detail of the study. Tables that currently appear rather sparse can be expected to become well populated as the case count increases. Note that no tally of "crash cause" exists, since, as mentioned previously, the LTCCS approaches a crash as a series of events with associated factors that may or not increase the risk of a crash.

Only after data quality control and applications of weighting factors will it be possible to make meaningful national estimates from LTCCS data. As mentioned above, preliminary tallies can provide some insight into the types of cases being collected in the study; the tabulations in this report are meaningful only for those purposes. **No national estimates of proportions, relationships, or risks should be inferred from them**.

Tallies in this report include summations of certain variables at the crash level (where the characteristic of interest applies to the *crash* as a whole) and at the vehicle level (where the characteristic of interest applies to each *vehicle* in the crash). Data collected and coded on the vehicle level can later be analyzed in many different ways, including the crash level and/or the truck level. At either level, the tabulations are divided into the following subject matter areas:

- Crash Types
- Vehicles
- Drivers
- Injuries
- Crash Event Assessment and Associated Factors

Until the study is complete, the database is constantly being updated as new cases are initiated and as new data are entered on older cases. Each case goes through several levels of quality control during which values of previously coded variables can change. At the time this report was completed, the LTCCS data file contained over 600 cases in various stages of completion. For the purpose of the preliminary data tallies presented here, only cases closer to completion and in the advanced coding stages were queried.

Cases included in the tallies in this report were from the pilot study and early stages of regular data collection and are in advanced coding stages. This means that data collection has been completed and coding of the crash event assessment form has been completed to a certain degree. As with every study, there is, to a certain extent, a learning curve over which techniques and documentation improve. Since the cases presented here represent the early cases, some data values are likely to be missing. In the following tables, when a tally includes data points with values that are missing or yet to be determined, those points are tabulated in the category "Incomplete Coding."

Each variable has several attributes. The tables show only the variable attributes for which there was a value; categories with counts of zero have been omitted.

Crash Types

As of September 10, 2002, over 600 LTCCS cases had been initiated, and 122 had been completed through advanced stages of Zone Center coding. These 122 are the basis of the tallies in the following sections. They have involved 126 large trucks and 116 other vehicles in single or multi-vehicle crashes. Table 5 summarizes the number of cases by the type of crash. Multiple vehicle crashes involve two or more vehicles with at least one of the vehicles being a large truck.

Table 5
Number of Cases
By Type of Crash
LTCCS Coded Crashes Through September 10, 2002

Type of Crash	Cases
Single Vehicle	28
Multiple Vehicle	94
Total	**122**

Source: Large Truck Crash Causation Study: Interim Report, September 2002, NCSA, NHTSA
No National Estimates or Analysis Should be Inferred from Preliminary Tallies

Crash type configuration, a vehicle level variable, describes the configuration in which each vehicle experiences the crash event. In each crash there may be several events. For example, a car may depart the road on the right side and strike a guardrail (event one); on the rebound, the car may strike a large truck (event two). The crash type configuration is descriptive of, but not the same as, the first harmful event for each vehicle. The first harmful event, also a vehicle level variable, is defined as the first damage or injury-producing event in the crash specific to that vehicle. In the example above, the first harmful event for the car was striking the guardrail, and the crash type configuration was right roadside departure. The first harmful event for the truck was striking another motor vehicle in transport, and the crash type configuration could have been forward impact with a vehicle in the same traffic way going in the same direction.

Table 6 shows the numbers of vehicles in the LTCCS early cases, categorized by the crash type configuration in their first harmful event. For clarity, it may be helpful to note that:

- the categories shown are not categories for the first harmful event, but for the crash type configuration;
- a single-vehicle event can occur within a multi-vehicle crash (thus the tallies show nine non-truck single vehicle events).
- some crashes involved more than one truck, resulting in the 126 trucks of Table 6 involved in the 122 crashes of Table 5.

Table 6 **Number of Involved Vehicles** **By Crash Type Configuration and Involved Vehicle Type** **LTCCS Coded Crashes Through September 10, 2002**		
Crash Type Configuration	**Involved Vehicle Type**	
	Truck	**Other Vehicle**
Single Vehicle Events		
Right Roadside Departure	8	5
Left Roadside Departure	11	4
Forward Impact	5	0
Subtotal	*24*	*9*
Same Traffic way, Same Direction		
Rear-end	26	24
Forward Impact	3	3
Sideswipe Angle	6	7
Subtotal	*35*	*34*
Same Traffic way, Opposite Direction		
Head-on	7	8
Forward Impact	5	2
Sideswipe Angle	2	4
Subtotal	*14*	*14*
Change Traffic way, Vehicle Turning		
Turn Across Path	10	7
Turn Into Path	5	6
Subtotal	*15*	*13*
Intersecting Straight Paths		
Straight Paths	11	9
Backing	3	4
Subtotal	*14*	*13*
Other		
Subtotal	*24*	*33*
Total	**126**	**116**

Source: Large Truck Crash Causation Study: Interim Report, September 2002, NCSA, NHTSA
No National Estimates or Analysis Should be Inferred from Preliminary Tallies

As mentioned previously, the first harmful event is the first damage or injury-producing event in the crash. It is determined and coded for each vehicle in the crash. Table 7 shows that for both trucks and all other types of vehicles, the most frequent first harmful event was a collision with another vehicle that was in motion. Collisions with non-occupants and with parked vehicles were relatively infrequent. The second most prevalent first harmful event for trucks was rollover (i.e. overturn).

Table 7 Number of Involved Vehicles By First Harmful Event and Involved Vehicle Type LTCCS Coded Crashes Through September 10, 2002		
First Harmful Event	**Involved Vehicle Type**	
	Truck	**Other Vehicle**
Non-Collision Events		
Overturn	16	0
Other Non-collision	1	0
Subtotal	*17*	*0*
Collision Events		
Pedestrian	3	0
Pedal cycle	2	0
Railway Train	1	0
Motor Vehicle in Transport	89	92
Parked Motor Vehicle	1	2
Concrete Traffic Barrier	3	4
Guardrail	2	2
Embankment – Earth	3	0
Other Post, Pole, or Support	1	0
Other Object (Not Fixed)	0	1
Tree	1	0
Thrown or Falling Object	0	5
Injured in Vehicle	0	1
Incomplete Coding	3	9
Subtotal	*109*	*116*
Total	**126**	**116**
Source: Large Truck Crash Causation Study: Interim Report, September 2002, NCSA, NHTSA **No National Estimates or Analysis Should be Inferred from Preliminary Tallies**		

Vehicle Types

The LTCCS pays due attention to the types of vehicles involved in large truck crashes. Detailed information is recorded on the vehicle body type and cargo body type of each truck in a sampled crash. “Combination Truck” is used to represent all tractor-trailers, including bobtails (tractors hauling nothing) and tractors hauling one or more trailers. There have been 42 single unit trucks, five single unit trucks pulling a trailer, and 79 combination trucks coded in LTCCS cases. Table 8 displays the numbers of involved vehicles by vehicle body type.

Table 8 **Number of Involved Vehicles** **By Vehicle Body Type** **LTCCS Coded Crashes Through September 10, 2002**	
Vehicle Body Type	**Involved Vehicles**
Single Unit Trucks	
2 Axles	22
3 or More Axles	20
Subtotal	*42*
Single Unit Trucks Pulling a Trailer	
Subtotal	*5*
Combination Trucks	
Tractor (Bobtail)	2
Tractor with 1 Trailer (Semi or Full Trailer)	76
Tractor with 2 Trailers	1
Subtotal	*79*
Trucks Total	***126***
Passenger Cars and Light Trucks	
Subtotal	*114*
Other Vehicles (e.g., Motorcycles and Buses)	
Subtotal	*2*
Non-Truck Vehicles Total	***116***
Total	**242**
Source: Large Truck Crash Causation Study: Interim Report, September 2002, NCSA, NHTSA **No National Estimates or Analysis Should be Inferred from Preliminary Tallies**	

Trucks are further classified in the LTCCS according to their cargo body type, a description more specific than the vehicle body type of Table 8. From the cases in the early part of the study, many body types have been sampled and investigated. Van-type trucks and dump trucks have been most frequently involved. Table 9 gives the numbers of involved trucks by cargo body type. For vehicles hauling more than one cargo type, the code used in these tallies was determined by the cargo type in the first trailer, or in the case of a single unit truck pulling a trailer, the cargo in the single unit truck.

Table 9
Number of Involved Trucks
By Cargo Body Type
LTCCS Coded Crashes Through September 10, 2002

Cargo Body Type	Involved Trucks
Van	49
Open Top Van	2
Refrigerated Van	13
Livestock Carrier	2
Flatbed	9
Low Boy	2
Flatbed with Equipment	3
Flatbed with Sides	1
Pole/Logging	2
Tank	2
Auto Carrier	1
Dump	19
Garbage/Refuse	3
Cement Mixer	2
Other (Specify)	9
Unknown	7
Total	**126**

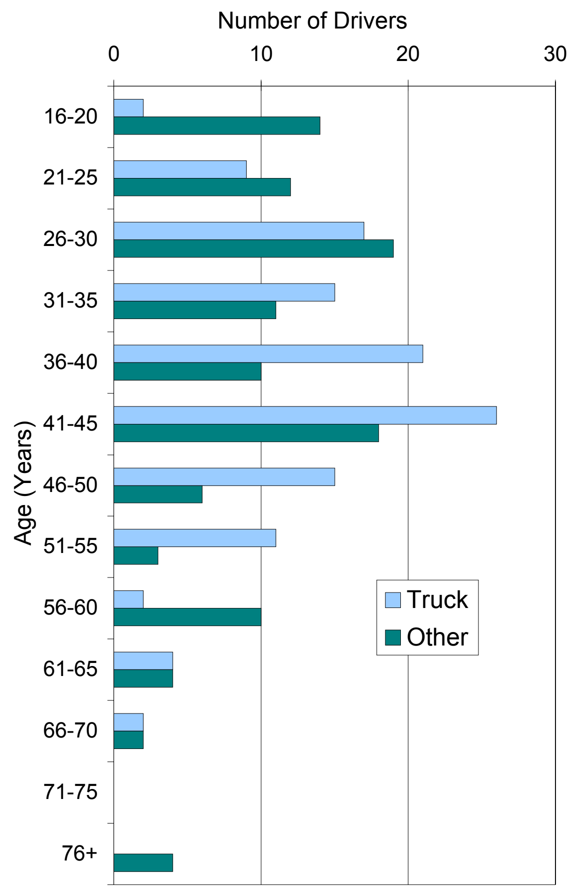
Source: Large Truck Crash Causation Study: Interim Report, September 2002, NCSA, NHTSA
No National Estimates or Analysis Should be Inferred from Preliminary Tallies

Drivers

Information about involved drivers is important to any crash investigation. In the LTCCS, investigators collect demographic information about truck and non-truck drivers as well as interview them and others for additional information. In the early LTCCS cases, most truck drivers were between the ages of 26 and 55 while the age of drivers in other vehicles was generally more distributed. Table 10 shows the distribution of driver ages seen so far in the LTCCS; the visual display is added for ease of comparison.

Table 10
Number of Drivers
By Age and Involved Vehicle Type
LTCCS Coded Crashes Through September 10, 2002

Driver Age (Years)	Involved Vehicle Type	
	Truck	Other Vehicle
16-20	2	14
21-25	9	12
26-30	16	19
31-35	15	11
36-40	21	10
41-45	26	18
46-50	15	5
51-55	11	3
56-60	2	10
61-65	4	4
66-70	2	2
71-75	0	0
76 or Older	0	4
No Driver Present	3	4
Incomplete Coding	0	0
Total	**126**	**116**



Source: Large Truck Crash Causation Study: Interim Report, September 2002, NCSA, NHTSA
No National Estimates or Analysis Should be Inferred from Preliminary Tallies

LTCCS investigators also collect the level and type of training that truck drivers have received. This variable can be broken down by truck type for added information. The numbers of drivers by training source and vehicle type in early LTCCS cases are shown in Table 11.

Table 11
Number of Truck Drivers
By Driver Training Source and Truck Type
LTCCS Coded Crashes Through September 10, 2002

Driver Training Source	Truck Type			
	Combination Truck	Single Unit Truck	Single Unit Truck Pulling a Trailer	Total
Community College, etc.	2	1	0	3
Company	18	7	1	25
Driving School	21	4	0	25
Military	3	1	0	4
None	11	16	1	28
Other (Specify)	10	5	1	16
Training, Source Unknown	2	3	0	5
Unknown	11	3	2	18
No Driver Present	1	2	0	2
Total	**79**	**42**	**5**	**126**

Source: Large Truck Crash Causation Study: Interim Report, September 2002, NCSA, NHTSA
No National Estimates or Analysis Should be Inferred from Preliminary Tallies

Injuries

An eligible LTCCS case must involve at least one police-reported injury of level of “K” (Killed), “A” (Incapacitating Injury), or “B” (Non-Incapacitating Injury) on the standard “KABCO” scale (Appendix). However, some cases without known injuries were investigated because LTCCS is an on-scene data collection effort. Selection of crashes is based on notification from law enforcement officials. Law enforcement officials have been encouraged to report crashes involving any visible sign of injury to minimize incorrect on-scene injury severity and maximize the number of notifications. Therefore, some crashes with low severity injuries will be included in the regular data collection sample. These cases will be statistically weighted accordingly in the final data set.

Injuries are recorded as occupant-level variables, but occupants are recorded as being within vehicles, and vehicles are recorded as being within cases. Thus it is simple to determine the maximum injury level within a vehicle or within a case. In the initial 122 cases, 25 crashes have had at least one occupant with a fatal injury. The largest category for maximum injury level has been “B” or non-incapacitating injury, appearing in 40 cases. Table 12 shows the number of cases by maximum injury level in the early LTCCS cases.

Table 12 Number of Cases By Maximum Injury Level in Case LTCCS Coded Crashes Through September 10, 2002	
Maximum Injury Level	**Cases**
K – Killed	25
A – Incapacitating Injury	35
B – Non-incapacitating Injury	40
C – Possible Injury	14
O – No Injury	8
Total	**122**

Source: Large Truck Crash Causation Study: Interim Report, September 2002, NCSA, NHTSA
No National Estimates or Analysis Should be Inferred from Preliminary Tallies

At the vehicle level, 25 vehicles – four trucks and 21 other vehicles - have had at least one occupant who sustained fatal injuries. Eighty out of 126 trucks had no injury, while only 19 out of 116 other vehicles had no injury. Thus in the early LTCCS multi-vehicle cases, the qualifying injury has more often been found in a vehicle other than a truck. Table 13 shows the number of LTCCS vehicles by maximum injury level and vehicle type.

Table 13 Number of Involved Vehicles By Maximum Injury Level and Involved Vehicle Type LTCCS Coded Crashes Through September 10, 2002		
Maximum Injury Level	**Involved Vehicle Type**	
	Truck	**Other Vehicle**
K – Killed	4	21
A – Incapacitating Injury	8	28
B – Non-incapacitating Injury	14	32
C – Possible Injury	19	12
O – No Injury	80	19
No Occupants Present	0	3
Incomplete Coding	1	1
Total	**126**	**116**

Source: Large Truck Crash Causation Study: Interim Report, September 2002, NCSA, NHTSA
No National Estimates or Analysis Should be Inferred from Preliminary Tallies

Crash Event Assessment and Associated Factors

After the researcher in the field collects all of the data from the scene, through interviews, from the motor carriers, etc., the case is sent to the Zone Center for quality control and coding of the Crash Event Assessment Form. This form is used to summarize the events of the crash and the associated factors to those events, using all of the other data in the case.

According to a method developed by K. Perchonok, (DOT-HS-053-1-109, July 1972), each crash has a sequence of events leading up to it. There is no one specific cause of a crash; rather, there exist several contributing factors and related events. The “critical event” is that which is the last in the chain of events after which the crash becomes imminent. The “critical reason” describes why the critical event took place. These two variables are located on the Crash Event Assessment Form.

There are a variety of environmental and other factors such as weather conditions, time of day, lighting conditions, the driver’s physical condition, and attentiveness that can be considered factors possibly associated with the crash. The LTCCS researchers code the levels of many such variables regardless of whether they contributed to the crash. At the end of the study, through statistical analyses, the relative risk approach will help determine whether certain conditions contribute to crashes. However, for reasons discussed earlier, the set of 122 coded LTCCS cases is not weighted for statistical evaluation. To show the kinds of cases being investigated that will eventually be available for analysis, the following section provides preliminary tabulations of some of the variables of high interest, including:

- Critical Event
- Critical Reason
- Atmospheric Conditions
- Lighting Conditions
- Alcohol
- Fatigue
- Distraction

Critical Event

The “critical precrash event” is the event that made the crash imminent or inevitable. This variable is coded for each vehicle and documents the circumstances leading to that vehicle’s first impact in the crash sequence.

Table 14 shows the types of critical events experienced by trucks and other vehicles in both single and multi-vehicle crashes.

Table 14 Number of Involved Vehicles By Critical Event, Crash Type, and Involved Vehicle Type LTCCS Coded Crashes Through September 10, 2002			
Critical Event	Crash Type		
	Single Vehicle	Multiple Vehicle	
	Trucks	Trucks	Other Vehicles
Vehicle Loss of Control			
Blow Out/Flat Tire	1	0	1
Disabling Vehicle Failure (e.g. Wheel Fell Off)	1	0	1
Poor Road Conditions (Puddle, Pot Hole, Ice, etc.)	1	1	2
Traveling Too Fast for Conditions	9	2	4
Other Cause of Control Loss	2	0	3
Unknown Cause of Control Loss	0	0	1
Subtotal	*14*	*3*	*12*
This Vehicle Traveling			
Over the Lane Line on Left Side of the Travel Lane	0	4	6
Over the Lane Line on Right Side of the Travel Lane	0	3	1
From Adjacent Lane (Over Right Lane Line)	2	0	0
Off the Edge of the Road on the Left Side	2	1	2
Off the Edge of the Road on the Right Side	4	2	4
Turning Left at Intersection	0	2	5
Turning Right at Intersection	1	2	2
Crossing Over (Passing Through) Intersection	0	2	12
This Vehicle Decelerating	0	0	2
Subtotal	*9*	*16*	*34*
Other Motor Vehicle in Lane			
Other Vehicle Stopped	0	8	8
Other Vehicle Backing	0	0	1
Traveling in Same Direction While Decelerating	0	6	3
Traveling in Same Direction with Low Steady Speed	0	1	4
Traveling in Same Direction with Higher Speed	0	13	14
Traveling in Opposite Direction	0	3	0
Unknown Travel Direction of Other Vehicle in Lane	0	1	0
Subtotal	*0*	*32*	*30*

Table 14 *(Continued)* **Number of Involved Vehicles** **By Critical Event, Crash Type, and Involved Vehicle Type** **LTCCS Coded Crashes Through September 10, 2002**			
Critical Event	**Crash Type**		
	Single Vehicle	**Multiple Vehicle**	
	Trucks	**Trucks**	**Other Vehicles**
Other Motor Vehicle Encroaching into Lane			
From Adjacent Lane (Same Direction) – Over Left Lane Line	0	5	3
From Adjacent Lane (Same Direction) – Over Right Lane Line	0	6	3
From Opposite Direction – Over Left Lane Line	0	9	5
From Crossing Street – Across Path	0	12	1
From Crossing Street – Turning into Same Direction	0	0	1
From Crossing Street – Turning into Opposite Direction	0	1	0
From Driveway - Across Path	0	0	1
From Driveway Turning into Same Direction	0	1	0
Subtotal	*0*	*34*	*14*
Pedestrian, Pedalcyclist, or Other Non-motorist			
Pedestrian in Roadway	2	0	0
Pedal cyclist or Other Non-motorist in Roadway	2	0	0
Subtotal	*4*	*0*	*0*
Object or Animal			
Subtotal	*0*	*0*	*0*
Others			
Other (Specify)	1	2	4
Unknown	0	0	0
Not Involved in First Harmful Event	0	9	20
Incomplete Coding	0	2	2
Subtotal	*1*	*13*	*26*
Total	**28**	**98**	**116**

Source: Large Truck Crash Causation Study: Interim Report, September 2002, NCSA, NHTSA
No National Estimates or Analysis Should be Inferred from Preliminary Tallies

Critical Reason

The "critical reason for the critical event," tallied in Table 15, is the immediate reason for the event and is often the last failure in the causal chain. Critical reason can be subjective in nature and is determined at the Zone Center by the case reviewer using all available information in the case. The most frequent driver-related critical reason in the preliminary LTCCS data was inadequate surveillance, occurring for 17 vehicles.

It is important to note that where a vehicle's critical event is coded as the action of another vehicle, such as in Table 14 categories under the headings "Other Motor Vehicle In/Encroaching Into Lane," the critical reason field is usually given the fill "Critical Event Not Coded to this Vehicle." Thus the relatively large counts in Table 15 for that category do not signify missing data.

There were five single vehicle crashes where the critical reason was "critical event not coded to this vehicle." Examples include a crash that resulted from an avoidance maneuver of a pedestrian in the roadway and a critical event that was coded to a non-contact vehicle.

Table 15
Number of Involved Vehicles
By Critical Reason, Crash Type, and Involved Vehicle Type
LTCCS Coded Crashes Through September 10, 2002

Critical Reason	Crash Type		
	Single Vehicle	Multi-Vehicle	
	Truck	Truck	Other Veh.
Driver			
Sleep, Actually Asleep	2	0	6
Heart Attack or Other	2	1	2
Other Critical Non-performance	1	0	1
Unknown Critical Non-performance	0	0	1
Inattention	1	0	7
Internal Distraction	0	2	3
External Distraction	0	1	1
Inadequate Surveillance	2	8	7
False Assumption	0	1	0
Other Recognition Error	0	0	1
Unknown Recognition Error	0	2	1
Too Fast for Conditions	1	4	1
Following Too Closely	0	3	0
Misjudgment of Gap or Other's Speed	0	1	6
Illegal Maneuver	0	0	3

Table 15 *(Continued)*
Number of Involved Vehicles
By Critical Reason, Crash Type, and Involved Vehicle Type
LTCCS Coded Crashes Through September 10, 2002

Critical Reason	Crash Type		
	Single Vehicle	Multi-Vehicle	
	Truck	Truck	Other Veh.
Other Decision Error	4	2	2
Unknown Decision Error	0	0	1
Overcompensation	0	1	1
Poor Directional Control	2	2	3
Unknown Performance Error	0	0	1
Type of Driver Error Unknown	0	0	4
Subtotal	*15*	*28*	*52*
Vehicle			
Tires/Wheels Failed	1	0	1
Brakes Failed	2	0	0
Other Vehicle Failure	0	2	0
Unknown Vehicle Failure	0	0	1
Subtotal	*3*	*2*	*2*
Environment			
Road Design	1	0	0
Slick Roads (Ice, Loose Debris, etc.)	2	0	4
Wind Gust	1	0	0
Fog	0	0	2
Glare	0	0	1
Subtotal	*4*	*0*	*7*
Others			
Unknown	1	2	2
Critical Event not Coded to this Vehicle	5	65	51
Incomplete Coding	0	1	2
Subtotal	*6*	*68*	*55*
Total	**28**	**98**	**116**

Source: Large Truck Crash Causation Study: Interim Report, September 2002, NCSA, NHTSA
No National Estimates or Analysis Should be Inferred from Preliminary Tallies

Atmospheric and Lighting Conditions

Atmospheric conditions and lighting conditions can be contributing factors in crash incidents. The full LTCCS will allow formal analysis of such conditions. Based on the coding of the first vehicle listed in the crash, the majority of early LTCCS cases have not involved adverse atmospheric conditions. Most cases have occurred in daylight. The atmospheric and lighting conditions for the current cases are tabulated in Tables 16 and 17.

Table 16
Number of Cases
By Crash Atmospheric Condition
LTCCS Coded Crashes Through September 10, 2002

Atmospheric Condition	Cases
No Adverse Conditions	98
Rain	9
Snow	8
Wind Gust	1
Other (e.g. Smog, Smoke, Blowing Snow)	2
Fog and Other	1
Rain and Other	1
Rain and Wind Gust	1
Snow and Sleet	1
Total	**122**

Source: Large Truck Crash Causation Study: Interim Report, September 2002, NCSA, NHTSA
No National Estimates or Analysis Should be Inferred from Preliminary Tallies

Table 17
Number of Cases
By Crash Lighting Condition
LTCCS Coded Crashes Through September 10, 2002

Lighting Condition	Cases
Dark	17
Dark, but Lighted	10
Dawn	2
Daylight	92
Dusk	1
Total	**122**

Source: Large Truck Crash Causation Study: Interim Report, September 2002, NCSA, NHTSA
No National Estimates or Analysis Should be Inferred from Preliminary Tallies

Alcohol

Blood alcohol concentration (BAC), measured in grams per deciliter, is another potential contributor to a crash situation. Table 18 shows the number of drivers involved in LTCCS crashes by their BAC test status. If a test was given, the test result is also coded in the LTCCS case; those data are not shown here due to small counts, but a majority was over the legal definition of intoxication (BAC of 0.10 g/dcl), this can be shown in the final analysis.

Table 18
Number of Drivers
By Blood Alcohol Concentration (BAC) Test Status
and Involved Vehicle Type
LTCCS Coded Crashes Through September 10, 2002

BAC Test Performed	Involved Vehicle Types	
	Truck	Other Vehicle
Test Performed	32	25
Test Given, Results Unknown	10	8
No Test Given	76	71
Unknown	5	8
No Driver Present	3	4
Incomplete Coding	0	0
Total	**126**	**116**

Source: Large Truck Crash Causation Study: Interim Report, September 2002, NCSA, NHTSA
No National Estimates or Analysis Should be Inferred from Preliminary Tallies

Fatigue

Driver fatigue is a potentially important contributing factor in highway crashes. Of the 242 vehicles involved in LTCCS crashes, 14 of the truck drivers and 14 of the other vehicle drivers were reported to have experienced driver fatigue prior to the crash (Table 19).

Table 19 Number of Involved Vehicles By Reported Driver Fatigue and Involved Vehicle Type LTCCS Coded Crashes Through September 10, 2002		
Reported Fatigue	**Involved Vehicle Type**	
	Truck	**Other Vehicle**
Fatigued	14	14
Not Fatigued	81	62
Condition Unknown	27	34
No Driver Present	3	4
Incomplete Coding	1	2
Total	**126**	**116**
Source: Large Truck Crash Causation Study: Interim Report, September 2002, NCSA, NHTSA **No National Estimates or Analysis Should be Inferred from Preliminary Tallies**		

Distraction

Driver distraction can be characterized in a few different ways. Tables 20 and 21 show contributing factors such as: inattention, exterior distractions, and interior distractions. Inattention means that the driver was preoccupied by some other thought process and not a specific task. There are a few cases in the early coded cases where inattention was present (see Table 20).

Table 20 Number of Involved Vehicles By Driver Inattention and Involved Vehicle Type LTCCS Coded Crashes Through September 10, 2002		
Inattention	**Involved Vehicle Type**	
	Truck	**Other Vehicle**
Family Problem	2	0
Personal Problem	1	3
Preceding Argument	1	1
Other	6	12
Unknown	14	30
No Inattention	97	64
No Driver Present	3	4
Incomplete Coding	2	2
Total	**126**	**116**
Source: Large Truck Crash Causation Study: Interim Report, September 2002, NCSA, NHTSA **No National Estimates or Analysis Should be Inferred from Preliminary Tallies**		

Numerous sources of driver distraction potentially exist both within and outside of the vehicle. In addition to the traditional distracting factors such as radios, food, drink, and tobacco products, there are new technologies and other modern conveniences such as telephones, computers, and navigational systems that may prevent the driver from devoting sufficient attention to the driving task. Table 21 displays the various levels of driver distraction that may have contributed to the crash. The table is broken down into two sections, exterior distractions and interior distractions. There may have been more than one distraction per driver.

Table 21
Number of Involved Vehicles
By Driver Distraction and Involved Vehicle Type
LTCCS Coded Crashes Through September 10, 2002

Distraction	Involved Vehicle Type	
	Truck	Other Vehicle
Interior Distraction		
Adjusting Radio/CD Player	1	1
Retrieving Object from Floor	1	0
Other	3	1
Unknown	19	34
No Interior Distraction	97	74
No Driver Present	3	4
Incomplete Coding	2	2
Total	**126**	**116**
Exterior Distraction		
Looking at Approaching Traffic	7	3
Looking at Outside Person	2	0
Looking at Previous Crash	2	3
Unspecified Outside Focus	2	0
Other	8	8
Unknown	16	29
No Exterior Distraction	86	69
No Driver Present	3	4
Incomplete Coding	0	0
Total	**126**	**116**

Source: Large Truck Crash Causation Study: Interim Report, September 2002, NCSA, NHTSA
No National Estimates or Analysis Should be Inferred from Preliminary Tallies

Other Variables

The preceding tables cover only a fraction of the variables being collected (over 1,000 coded data elements) in the LTCCS. Each LTCCS investigation gathers detailed information on many other crash characteristics, including (but not limited to):

- Precrash environmental data
- Roadway surface conditions/defects
- Cargo weight
- Pedestrian/pedal cyclist/skater data
- Federal rating of motor carrier
- Truck conspicuity
- View line obstructions
- Cargo shift
- Driver citation history
- Driver years of experience
- Driver second job
- Driver hours on duty/schedule/over hours
- Driver physical condition/medications
- Driver sleep conditions/patterns preceding crash
- Suspected aggressive driving behavior (noted by researcher)
- Driver attention issues
- Driver perception issues

Upon completion of the study, using weighted data, such data on such factors can be mined for associations among themselves and with various crash scenarios, outcomes, and relative risks. Some ideas for testing hypotheses of association among factors and outcomes could include the following:

- Override or underride vs. the presence of truck underride guards
- Truck conspicuity vs. lighting conditions
- Vision-related crashes vs. the presence of supplemental mirrors
- Driver fatigue vs. first harmful event
- Record of previous violations vs. crash involvement

For more detail about all of the variables being collected in the LTCCS refer to the data collection forms included on the compact disc accompanying this report.

APPENDIX

About the CD

The CD packaged in this report contains the following:

- Data collection forms used in the Large Truck Crash Causation Study
- Editing and coding manuals for the data collection forms
- Electronic version of this report
- Traffic Safety Facts 2000: A Compilation of Motor Vehicle Crash Data from the Fatality Analysis Reporting System and the General Estimates System. This report combines data from NHTSA's two key crash databases that provide statistics on traffic crashes of all severities.
- Traffic Safety Facts Sheet 2000 for Large Trucks
- Sample cases from the Large Truck Crash Causation Study pilot phase

All files on the CD have portable document format (.pdf) file extensions and require the use of Acrobat Reader. More information about Acrobat Reader can be found at http://www.adobe.com/products/acrobat/.

To begin exploring the CD, open the "Table of Contents" by either of two methods:

First Method

1. In Windows, click "Start".
2. Select "Run".
3. Type the following,

   "Your CD-ROM drive letter:\TOC.htm"

   (Example; F:\TOC.htm)
4. Select "OK"

or,

Second Method

1. Review contents of CD by double clicking on the desktop icon "My Computer"
2. Select your CD drive
3. Locate filename, "TOC.htm"
4. Double click the file.

Use the "Table of Contents" as your guide.

Sample Case Review

The following twelve case summaries are for crashes investigated during the pilot phase of LTCCS. These twelve cases are located on the enclosed compact disc. Instructions for displaying these cases are:

To begin, place the compact disc in your CD-ROM drive.
In Windows, click "Start" located on the task bar.
Select "Run".
Type in the following,
"Your CD-ROM drive letter:\CDDATA\CDVIEW.exe"
(Example; F:\CDDATA\CDVIEW.exe)
Then select "OK". NASS logo appears on screen.

You are now ready to begin reviewing truck cases using NASSMAIN software.

Navigating Through an LTCCS Case Using the NASSMAIN Interface

NASSMAIN is software designed to review the many data elements contained within a NASS case. The instructions below help to navigate through the many screens of interesting data. The "action" required by the user is described first then followed by the "result" the user should see on the screen. It will be useful if basic Microsoft Windows skills are known. Skills like minimizing and maximizing window views and repositioning of these windows will be useful when displaying the many screens of available data.

ACTION: Select: File ➪ View ➪ All
RESULT: List of 12 demonstration cases on CD

ACTION: Click any row to select a case, then click green arrow, or
Double click any item in row of desired case.
RESULT: Case opens in display mode with "*Truck Case #: Display Mode*" in upper blue bar. *Case Form* appears with 7 tabs, *"Crash", "Structure", "Summary", "Events", "Vehicle", "Persons", "Scene"*.

ACTION: On the *Case Form* click on the *"Summary"* tab.
RESULT: Read the "case summary". This is a preliminary summary written by the NASS truck researcher in the field. General information on roadway data is given as well as crash configuration.

ACTION: On the *Case Form* click on the *"Scene"* tab.

RESULT: This gives a good visual of the crash. Double click in the scene for a separate window. Minimize this window for future reference.

ACTION: On the *Case Form* click on the *"Summary"* tab again.
RESULT: There should be one tab for each vehicle involved in the crash.

ACTION: Click on the *"Veh #x"* tab.
RESULT: This is the discussion prepared by the Zone Center after the Crash Event Assessment Form (CEAF) has been coded. It contains the contributing factors and circumstances for that vehicle and driver.

ACTION: Click on *"Components"* located under upper title bar. Eight categories appear on the pull-down menu. Click on *"Assessments"* and choose *"Crash"*.
RESULT: A CEAF has been coded for each vehicle. Choose the vehicle of interest. The first tab is called *"Pre-crash events"*. Here you can find the *"critical event"* and the *"critical reason for the critical event"*. To locate all of the contributing factors in the crash, browse through the various tabs on the CEAF.

Other data (over 1,000 elements) are available throughout the case. Clicking on *"Components"* and using the pull-down menu will display categories for General Vehicle, Exterior Truck, Exterior Vehicle, Interior Vehicle, Occupants, Assessments, Pictures (Images), and Thumbnails. These eight categories contain all of the data and photographic images needed to review a case. The Thumbnails category is especially useful because all photographic images are displayed. Double clicking on any image will enlarge it for better viewing.

Sample Case Summaries

Pilot Study Case # 2001-002-001
ANGLE/SIDESWIPE COLLISION

Vehicle #1, a 1991 Saturn 2-door coupe, was traveling west on a two-lane undivided county road with a grade of +4.9% approaching an intersection controlled by a stop sign. Vehicle #2, a 1998 Freightliner FL70 straight truck, was traveling north on a two-lane undivided state road that is straight with a grade of -2.5% approaching the same intersection. Vehicle #2 had a black on yellow 35 mph intersection warning sign with flashing yellow beacons activated, which was observed by operator. Vehicle #1 stops at stop sign, operator looks right then left and waits for two vehicles to pass from the right. Operator looks right then left again, does not observe Vehicle #2 and proceeds into the intersection with the intention of crossing straight through intersection to the opposite roadway. Her focus was straight ahead just prior to the collision. Operator of vehicle #1 was newly licensed (8 days), had never been on this roadway before, and was lost at the time. Operator of vehicle #2 observes vehicle #1 enter the intersection and sounds city horn. He had no time to reach for air horn. He observed a rock embankment ahead to his right and no vehicles in the opposing lane as possible avoidance areas. He applied the brakes with lock-up, steering to the left and was skidding longitudinally less than 30 degrees. Vehicle #1 continues and is struck in the left side by the front of vehicle #2 in the center of the intersection. Vehicle #1 is rotated clockwise into the northbound lane, continues off the right side of the roadway striking a mailbox post with the front and comes to rest facing in a northerly direction. Vehicle #2 continues off left side of roadway and comes to rest at the northwest corner of the intersection facing in a northwesterly direction. The weather was clear, the roadway dry and it was daylight at the time of the collision. Vehicle #1 was towed due to damage and vehicle #2 was driven from the scene. Operator of vehicle #1 was transported, treated, and released at a local hospital. Operator of vehicle #2 was not injured. It should also be noted that operator of vehicle #1 had only been licensed for 8 days prior to the collision.

Pilot Study Case # 2001-002-002
ROLLOVER

Vehicle #1, a 1993 Ford Escort, traveling south on four-lane divided (painted flush median strip, two lanes each direction) roadway in left lane. Vehicle #2, a 1994 Freightliner FLD 120 tractor pulling an open topped 1994 Spec trailer fully loaded with scrap metal, traveling west on two-lane divided (jersey barrier) roadway approaching a one way exit ramp. The exit ramp was marked with a 25 mph black on yellow warning sign, slippery when wet. (**Witness, who is a DOT Truck Inspector, was following vehicle #2, stated that scrap metal had been flying out of trailer for several miles. A mile or so prior to the crash, the witness stated that vehicle #2 came off a bridge while negotiating a right curve and the trailer leaned severely to the left. He felt that the trailer might roll at that point and possibly the trailer had a broken spring. The trailer straightened and vehicle #2 continued west.) Vehicle #2 enters exit ramp, which curves to the right, begins as an uphill grade (+4%), crests, and goes downhill (-6% grade), where it enters same trafficway being traveled by vehicle #1. Curve is also superelevated (+6%). Vehicle #2 overturns onto its left side and slides into the northbound lanes. The cargo from vehicle #2 scatters across northbound lanes into the southbound lanes and is observed by operator of vehicle #1. Operator of vehicle #1 comes to a stop in southbound left lane and cargo strikes the front end of vehicle #1 and continues underneath. Operator of vehicle #1 backs vehicle away from debris and pulls to the southbound shoulder. Vehicle #2 comes to rest on its left side across both northbound lanes and the acceleration lane facing in a northerly direction. The weather was cloudy, the roadway dry and it was daylight at the time of the crash. Vehicle #2 was towed due to damage. There were no reported injuries.

Pilot Study Case # 2001-008-001
REAR END COLLISION

Vehicle #2 was a 1999 Mack RD6885 four-axle dump truck with two occupants. The vehicle was empty and the lift axle (axle #2) was not in use. Vehicle #1 was a 2001 Chevrolet Silverado pickup truck with three occupants. The crash occurred on a four-lane asphalt roadway at a point where there is a third northbound lane for left turns. The speed limit is 40mph and traffic is divided by a 0.7m wide mountable median. The road surface was dry. Impact took place in the northbound curb lane at the south side of a four-way intersection. The intersection is controlled by a traffic signal that was red for northbound traffic. The approach to the intersection curves slightly to the left with a radius of 203m. There is a hillcrest 152m prior to the point of impact. The grade just north of the hillcrest is -10% and it levels to -3% at the point of impact. Visibility was not a factor. There was a clear line of sight from 134m prior to the impact, the sky was cloudy and the sun was behind the vehicles. The windshield of vehicle #2 was clear of any obstructions. Both vehicles were heading north in the northbound curb lane; vehicle #1 was in front of vehicle #2. Vehicle #1 was stopped at the intersection for a red traffic signal. The driver of vehicle #1 was not aware of vehicle #2's collision course and took no avoidance actions. The driver of vehicle #2 applied the brakes and brakes on the right side of vehicle #2 locked approximately 34m prior to impact. Vehicle #2 began to skid longitudinally, drifting right until the right front tire contacted a 17cm curb. The front of vehicle #2 contacted the back of vehicle #1. Vehicle #2 came to rest heading north in the northbound curb lane, at the intersection. Vehicle #1 was propelled forward and left into the intersection. Vehicle #1 came to rest heading northwest within the intersection off of the southwest corner. All three occupants of vehicle #1 were transported to a medical facility. The driver of vehicle #1 reported facial and neck pain. Occupant #2 in vehicle #1 reported neck pain. Occupant #3 in vehicle #1 was not injured. The driver of vehicle #2 indicated that he was very comfortable with the maintenance and condition of the vehicle prior to this trip. He stated that the engine retarder was activated, but not long enough to be effective. An inspection of the brakes revealed that the left rear brake for vehicle #2 was inoperative and that the remaining left side brakes were out of adjustment. The driver of vehicle #2 indicated that he was not on a schedule, and he was returning to his company to end his workday. The driver of vehicle #2 did not provide an estimate of travel speed. There were no reported witnesses.

Pilot Study Case # 2001-009-004
HEAD-ON COLLISION

Vehicle #1, a 1998 Ford F150, was traveling south on a six lane divided roadway. For unknown reasons, vehicle #1 moved towards the center median and collided with the curb (event one). Vehicle #1 crossed into the opposing lanes traveling the opposite direction of traffic. Vehicle #1 then entered an entrance ramp for northbound traffic still traveling against traffic where it collided head-on (event 2) with vehicle #2, a 1988 Mack dump truck. The driver of vehicle #1 was transported by helicopter to the hospital and vehicle #1 was towed due to damage. The driver of vehicle #2 was reported to be uninjured and vehicle #2 was towed due to damage. Witnesses on scene reported that the driver of vehicle #1 was throwing beer cans out his window prior to start of collision course and unopened beer cans were observed in his vehicle following the collision. Subsequent hospital tests indicated that the driver had no alcohol in his system.

Pilot Study Case # 2001-011-001
OBJECT OFF ROAD COLLISION

Vehicle #1, a 1994 Freightliner tractor pulling a single semi trailer, was northbound in lane 1 of the two northbound lanes of a controlled access, interstate roadway with a positive median barrier (metal guardrail). Vehicle #1 "drifted" into lane 2 then drove into the median. Vehicle #1, front, contacted steel, median guardrail on an angle, and then proceeded to a stop in the median. Vehicle #1 suffered damage to the tractor only, there was no spillage of the general freight cargo and both tractor and trailer were towed. Witnesses at the scene think the single occupant of vehicle #1 may have suffered a heart attack. EMS personnel were unable to revive the driver who had expired before being removed from the vehicle. Vehicle #1 was 75% loaded and was delivering the general freight from one state to another. The driver did not load the truck and had plenty of time to make his delivery. The entire trip was less than 300 miles with the final leg of his trip less than 200 miles. He began his final leg during the early morning hours and was involved in the crash 50 minutes after resuming his trip. The driver had only been driving full time professionally for 5 weeks but had trained with his cousin who owned the truck and paid him by the load even though the truck was leased to the carrier who paid by the mile. The driver had driven this truck for three weeks but it was the first time he had driven this route. He had a recent physical with no restrictions and a clean driving record. The driver was taking prescribed medication for high blood pressure and been diagnosed with sleep apnea four years before. He used a C-PAP machine to aid with his sleeping (which was in the truck at the time of the crash). This was a single vehicle crash involving a semi tractor trailer that involved the driver suffering a major hear attack which caused his death and most probably caused him to loss control of the vehicle. He suffered a cut to his head, which didn't bleed indicating that he may have suffered a fatal heart attack before the impact, which resulted in his head contacting the interior of his truck. This indicates that his sleep apnea was not a direct cause of this crash.

Pilot Study Case # 2001-043-001
RIGHT ANGLE COLLISION

Vehicle #1, a 1999 Toyota 4Runner, was stopped on a two-lane road at a four-way intersection. Vehicle #2, a 1995 Volvo tractor hauling a trailer of scrap metal, was traveling north on a three lane divided state highway approaching the same intersection. Vehicle #3e, a 1999 Chevrolet 6500 towing a trailer, was traveling south on the same highway attempting to turn left at the intersection. The weather was clear and the road was dry. Opposite of vehicle #3 was a northbound vehicle turning south. This unknown vehicle reduced the visibility of vehicle #2 to the driver of vehicle #3. Vehicle #3 entered the intersection and turned in front of vehicle #2. Vehicle #3 accelerated to avoid the crash. Vehicle #2's driver applied the brakes to avoid the crash. Neither avoidance maneuvers were successful. The front of vehicle #2 struck the right side of vehicle #3's trailer and the bumper from vehicle #2 landed on vehicle #1's hood. Following the impact, vehicle #3 drove to the shoulder. Vehicle #2 dragged vehicle #3's trailer until it came to final rest in the northbound grass median. The driver of vehicle #2 sustained "B" injuries and was treated and released at a local trauma center. No other injuries were sustained. Vehicle #2 was the only vehicle towed from the scene. A post crash inspection did not discover any mechanical problems with vehicle #2 or vehicle #3. The driver of vehicle #3 was cited for operating a vehicle without a CMV permit, no record of a medical card, an expired Federal Inspection sticker, and a failure to yield violation. The driver of vehicle #3 reported that a vehicle making a turn at the same intersection obstructed his view of northbound traffic. He admitted the crash was his fault because he didn't wait to see if the traffic was clear.

Pilot Study Case # 2001-043-006
SIDESWIPE COLLISION

Vehicle #1 and vehicle #2 were traveling in opposite directions on the same two-lane undivided roadway on a Tuesday, approximately at 10am. The road was straight with no defects and a posted speed of 45mph. The weather was clear with a slight wind of 26 knots. Vehicle #1 was a Kenworth tractor with an empty logging trailer. Vehicle #2 was a 1998 Pontiac Firebird with one occupant. Vehicle #1 delivered logs earlier in the morning the delivery site was less than 5 miles from crash and was returning to pick up another load. As vehicle #2 traveled north, she saw vehicle #2 drift into her lane. The driver of vehicle #2 was traveling south to his home after completing his shift as a bag handler at the airport, which was 20 miles from the crash. Vehicle #2 drifted into the northbound lane and struck vehicle #1's left side fuel tank. Vehicle #2 spun counterclockwise and came to rest off the southbound road edge. Vehicle #1 departed the road on the right side, but returned to the roadway where it came to final rest in its original travel lane. Both vehicles were towed due to damage. The driver of vehicle #1 was not injured. The driver of vehicle #2 sustained "A" injuries and was hospitalized for five days. The State climate office reported wind speeds of 26 knots per hour at 10am on the day of the crash. The average wind speed is normally 7 - 13.

Pilot Study Case # 2001-045-001
REAR END COLLISION

The roadway is a two-lane, rural, east/west, arterial roadway with private drives along the north side of the road. Conditions were daylight and dry. A non-contact vehicle was ahead of a group vehicles traveling eastbound. The vehicles had been stopped at a signal-controlled intersection, which was 140m west of the crash scene. The non-contact vehicle was in front, followed by vehicle #1 (car), vehicle #2 (pickup truck), and vehicle #3 (heavy straight truck). The non-contact vehicle stopped abruptly, waiting for oncoming traffic to clear in order to make a left turn into a private drive on the north side of the road. Vehicle #1 and vehicle #2 were forced to brake suddenly, but were able to avoid collisions. Vehicle #3 left 11m of skid marks, but was unable to stop in time. Vehicle #3's front struck vehicle #2's back, causing a chain reaction with vehicle #2's front striking vehicle #1's back. All the vehicles came to rest facing eastbound with vehicle #1 off the right side of the road, vehicle #2 in the middle of the road, and vehicle #3 in its original lane. The driver of vehicle #1 was belted. Vehicle #1 passenger, vehicle #2 driver, and vehicle #3 driver were not belted. The only injury in the crash was to vehicle #2 driver, who was treated and released from a hospital with a laceration to the back of the head. The left front seatback failed in vehicle #2 and moved to a completely rearward position, causing vehicle #2 driver's head to hit the back window. It appears that the non-contact vehicle, vehicle #1, and vehicle #2 did stop abruptly, but had been stopped 2-3 seconds prior to initial collision. During interviews the driver of vehicle #1 added some interesting information. He states that he overheard vehicle #3 driver at scene state "I looked up and traffic was stopped." During the researcher's interview of vehicle #3 driver, he contradicted himself along those lines stating, "I was looking forward entire time," however he also said "I never even saw their brake lights."

Pilot Study Case # 2001-045-002
RAN OFF ROAD/ROLLOVER COLLISION

Vehicle #1 was southbound on a four-lane median divided highway. Conditions were daylight and dry. Vehicle #1 exited the highway to the left on a one-lane exit ramp that merges on to a separate two-lane highway several hundred meters south. The exit ramp is straight for 150m before making a sharp curve to the left. While negotiating the left curve vehicle #1 edged on to the paved right shoulder and rolled. The vehicle rolled 3/4 turns before coming to rest on its left side, facing east in a grass median 22m southeast of roll initiation. The tractor with tank trailer, which was carrying 8200 gallons of gasoline, burst into flames 10-15 seconds after impact and the belted driver was a fatality. The vehicle was completely burned destroying possible evidence, however based on investigation it appears there were four factors in the crash. While none of these factors alone would have caused the crash, in combination they could account for the rollover. The first factor was a defective leaf spring assembly. The main leaf spring on the right rear trailer was out of its housing. Based on the wear pattern on the bolt, it appears the leaf spring was out of the housing for sometime before the crash. The second factor was cargo shift. The tanker had four compartments and was filled to 86% of capacity. However, while three of the compartments were filled to within 100 gallons of capacity the third compartment going rearward had a capacity of 2100 gallons but was only filled with 1500 gallons. According to truck inspectors, this would allow for some cargo shift. It's also interesting to note that the rear trailer tires, near the third compartment, caused the initial rollover gouge. The third factor was excessive curvature. The exit ramp makes an abrupt 90-degree left turn and has a posted speed of 25mph. The fourth factor was excessive speed around the curve for this type of vehicle. While all the witness' state that the vehicle was not traveling at a high rate of speed, the weight of the vehicle would necessitate very slow speeds in this particular situation. The driver of the vehicle was a 66-year-old male with no prior significant medical history. He had been driving a truck for approximately 30 years and was familiar with the roadway, tractor, and hauling tankers. The driver was on a normal weekly delivery schedule and had been on duty for 8 1/2 hours at the time of the crash and normally worked 9-12 hour days. Sleep patterns and fatigue are unknown because the driver lived alone with no family.

Pilot Study Case # 2001-048-001
JACKKNIFE / RUN OFF ROAD

Vehicle #1, a 1996 Kenworth tractor with a refrigerated trailer, was traveling south in the right lane on a four-lane divided interstate. There was a grass depressed center median with parallel alignment in a "V" ditch configuration. It was snowing and the road conditions were icy and snow covered. This stretch of urban interstate was unlighted and the crash occurred at 0515 hours prior to sunrise. The driver noticed a vehicle that had been following him for the past fifteen minutes began to pass him in the left lane. As the non-contact vehicle passed him it began to slide on some ice. The driver of vehicle #1 touched his brakes to attempt to back off and let the vehicle go on and his trailer began to slide on the ice. The back of the trailer swung left and the driver attempted to steer the cab straight in hopes that the rig would straighten itself out. The cab then began rotating counterclockwise and the combination jackknifed as it began to slide into the left lane and then off the left side of the road. After the truck departed the left side of the road into the median, the front impacted the back slope of the ditch. The trailer continued to slide around the tractor into the median and the vehicle came to final rest facing north in the ditch. The restrained driver was transported and released with a scalp contusion and back strain. Vehicle one was towed due to disabling damage.

Pilot Study Case # 2001-049-001
SIDESWIPE/ANGLE COLLISION

This crash occurred at 0905 hours on the southbound side of a divided, six-lane straight interstate freeway with a positive barrier (e.g. concrete median barrier) and grass center median. The posted speed limit was 97kph (e.g. 60mph). The precrash area of the freeway was comprised of a hillcrest overpass. At the top of the hillcrest bridge, the shoulders were bordered by a bridge railing comprised of cement Jersey barrier topped with a metal railing. The crash occurred on the down slope of the bridge approaching a connecting on-ramp. At the time of the crash, snow and ice covered the shoulders and the travel lanes were dry. Vehicle #1 was a 1996 Ford Contour four-door sedan that was in the left number three lane. Vehicle #2 was a three axle 1996 Freightliner tractor pulling one trailer and was in the center, number-two, southbound lane. There was no load in vehicle #2's trailer. As both vehicles were traveling straight, vehicle #2 drifted into the left lane. The driver of vehicle #1 observed this and said she eased off of the accelerator. As vehicle #2 was returning to its original lane, its left side impacted the right side of vehicle #1 near the right front tire. Vehicle #1 then began to rotate counterclockwise and then the left side of vehicle #2 again impacted the rear plane of vehicle #1. Vehicle #1 then departed the left side of the travel lanes and impacted the cement bridge railing with its front plane and was then redirected across the travel lanes. Vehicle #1 came to final rest facing opposite its original travel direction in the number one southbound travel lane. Vehicle #2 had continued southbound and stopped down the road from vehicle #1's final rest. The rear of the vehicle #1 was heavily damaged. The truck was not towed, and the driver was not injured. The car was towed and both occupants were transported to a medical facility with "B" injuries.

Pilot Study Case # 2001-081-001
RAN OFF ROAD COLLISION

This is a single vehicle crash that occurred on a six-lane freeway divided by a center, depressed grass median in a "V" ditch configuration. At the location of the crash, the road has a slight downgrade. The crash occurred at 0915 hours in daylight conditions and a temperature of 26 degrees Fahrenheit. It was snowing at the time of the crash and there was ice visible on the roadway. The police reported the white travel lane lines were not visible at the time of this crash. The speed limit when no adverse weather conditions are present is 89kph (e.g.55mph). Vehicle #1 is a 1993 White/GMC tractor pulling a 1986 14.6 meter (e.g. 48 feet) long utility trailer with produce. The driver of vehicle #1 stated he was traveling westbound in the number one lane following a non-contact large truck. The driver of vehicle #1 indicated he was traveling between 66 and 80kph (e.g. 41 and 50 mph) immediately prior to the lost of control. The driver observed the non-contact vehicle began to slide on the icy roadway. The driver assumed control of the non-contact had been lost and attempted to change lanes in order to avoid contact with the truck ahead. The driver began to steer left and to brake on the icy roadway. Vehicle #1 crossed all three lanes and slid off the roadway into the median. The vehicle struck the back slope of the grassy embankment with its front plane and then the tractor jackknifed causing intra-unit damage. The vehicle came to rest in the center median facing northwest. The driver of vehicle #1 sustained knee and chest injuries and was transported for treatment. Vehicle #1 was towed due to damage.

2000 National Motor Vehicle Statistics

2000 National Motor Vehicle Statistics		
Police-Reported Motor Vehicle Traffic Crashes		
Fatal	37,409	
Injury	2,070,000	
Property Damage Only	4,286,000	
Total	**6,394,000**	
Traffic Crash Victims	**Killed**	**Injured**
Occupants		
Drivers	25,492	2,063,000
Passengers	10,669	992,000
Unknown	88	—
Nonmotorists		
Pedestrians	4,739	78,000
Pedalcyclists	690	51,000
Other/Unknown	143	5,000
Total	**41,821**	**3,189,000**
Other National Statistics		
Vehicle Miles Traveled	2,749,803,000,000	
Resident Population	274,633,905	
Registered Vehicles	217,028,324	
Licensed Drivers	190,625,023	
Economic Cost of Traffic Crashes (1994) (estimate for reported and unreported crashes)	$150.5 billion	
National Rates: Fatalities		
Fatalities per 100 Million Vehicle Miles Traveled	1.5	
Fatalities per 100,000 Population	15.23	
Fatalities per 100,000 Registered Vehicles	19.27	
Fatalities per 100,000 Licensed Drivers	21.94	
National Rates: Injured Persons		
Injured Persons per 100 Million Vehicle Miles Traveled	116	
Injured Persons per 100,000 Population	1,161	
Injured Persons per 100,000 Registered Vehicles	1,469	
Injured Persons per 100,000 Licensed Drivers	1,673	

Sources: Crashes, Fatalities, Injuries, and Costs—National Highway Traffic Safety Administration.
Population—U.S. Bureau of the Census. Note: The population shown here is a projection based on the 1990 Census, in order to remain consistent with the population data used for other tables in this report.
Vehicle Miles Traveled—Federal Highway Administration.
Registered Vehicles—R.L. Polk & Co. and Federal Highway Administration.

2000 National Large Truck Statistics

2000 National Large Truck Statistics

Police-Reported Crashes Involving Large Trucks		
Fatal	4,573	
Injury	96,000	
Property Damage Only	337,000	
Total		
Vehicle Involvement in Traffic Crashes	**In Fatal Crashes**	**In Injury Crashes**
Large Trucks	4,930	101,000
Large Truck Traffic Crash Victims	**Killed**	**Injured**
Large Truck Occupants		
Drivers	647	25,000
Passengers	90	6,000
Unknown	4	—
Other Vehicle Occupants	4,060	106,000
Nonmotorists	410	3,000
Total	**5,211**	**140,000**
Other Large Truck National Statistics		
Vehicle Miles Traveled	205,791,000,000	
Registered Vehicles	8,022,649	
National Large Truck Rates: Fatalities		
Fatalities per 100 Million Vehicle Miles Traveled	1.2	
Fatalities per 100,000 Registered Vehicles	14.99	
National Large Truck Rates: Injured Persons		
Injured Persons per 100 Million Vehicle Miles Traveled	94	
Injured Persons per 100,000 Registered Vehicles	1,164	

Sources: Crashes, Fatalities, Injuries, and Costs—National Highway Traffic Safety Administration.
Population—U.S. Bureau of the Census. Note: The population shown here is a projection based on the 1990 Census, in order to remain consistent with the population data used for other tables in this report.
Vehicle Miles Traveled—Federal Highway Administration.
Registered Vehicles—R.L. Polk & Co. and Federal Highway Administration.

Glossary

Incapacitating injury[1]

An incapacitating injury is any injury, other than a fatal injury, which prevents the injured person from walking, driving or normally continuing the activities the person was capable of performing before the injury occurred.

Inclusions:

- Severe lacerations
- Broken or distorted limbs
- Skull or chest injuries
- Abdominal injuries
- Unconsciousness at or when taken from the accident scene
- Unable to leave the accident scene without assistance
- And others

Exclusions:

- Momentary unconsciousness
- And others

Nonincapacitating evident injury[1]

A nonincapacitating evident injury is any injury, other than a fatal injury or an incapacitating injury, which is evident to observers at the scene of the accident in which the injury occurred.

Inclusions:

- Lump on head, abrasions, bruises, minor lacerations
- And others

Exclusions:

- Limping (the injury cannot be seen)
- And others

Possible injury[1]

A possible injury is any injury reported or claimed which is not a fatal injury, incapacitating injury or nonincapacitating evident injury.

Inclusions:

- Momentary unconsciousness
- Claim of injuries not evident
- Limping, complaint of pain, nausea, hysteria
- And others

[1] ANSI D16.1 – 1996, "Manual on Classification of Motor Vehicle Traffic Accidents, Sixth Edition, National Safety Council, 1997

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